JPRS 77236

26 January 1981

China Report

SCIENCE AND TECHNOLOGY

No. 79

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NATIONAL DEVELOPMENTS

UFO PHENOMENON IN CHINA ANALYZED

Shanghai ZIRAN ZAZHI [NATURE JOURNAL] in Chinese No 9, Sep 1980 pp 685-686

[Article by Cha Leping [2686 2867 1627] and Lin Hongjing [5677 4767 2468]: "Preliminary Survey of Unidentified Aerial Phenomena in China"]

[Text] Every country in the world has had large numbers of reports giving eyewitness accounts of unidentified flying objects (UFO's). During the past half year, fans of the study of UFO phenomena in 15 of China's provinces, municipalities and autonomous regions have also collected and exchanged almost 100 examples of eyewitness accounts. This shows that in the vast territory of China, UFO's objectively exist as a phenomenon.

Reports about unidentified flying objects may be divided into three categories on the basis of their shapes.

The first type has been described as being like a disk or a globe in shape, with some being ovular or egg shaped. During daylight hours, they frequently appear as being silver in color, while at night they emit an orange-red brilliance. They are frequently accompanied by a white smoke cloud that has been emitted. This type has appeared in about 80 percent of the reports. The following are several fairly classic real examples.

At 2100 hours on 13 November 1978, Zhang Zhengmin [1728 1767 2402], a student in the 76th class of the Department of Space Physics at Wuhan University returned to his dormitory from the school library. As he entered the door, he said that the "moon" in the west was really frightening and had become much larger than usual. His roommates, Cheng Shanda [4453 1472 1129] and Han Erfan [7281 0059 4907] did not believe him because at this hour the moon should be in the east. The three thereupon rushed out of the room to take a look and sure enough, there in the west at a 40° angle of elevation in a clear night sky was a round object with a visual diameter of about 1 degree, giving off an orange-red light at a light intensity slightly less than of a full moon. The top part of the object was covered with a slowly curling cloud mass. The concealed portion was at times large and at times small. The entire object was slowly flying in a west by north direction, its color becoming deeper and deeper, and its brightness also gradually diminishing, but its visual diameter showed no apparent decrease in size. Classmate Cheng Shanda said, "There was complete silence at the time, and the three of us felt a little afraid. When the chemistry building blocked our view of the object, we raced to the top of the big library (a high place) to look at it some more, but we don't know where it flew. The entire period of observation was about 10 minutes, and some pedestrians in the street also stopped to watch it." This example of an observation of a flying object was quite representative. More than 10 examples reported from another nine provinces and municipalities also described flying objects in either exactly the same way or extremely similarly. Among them, two examples also reported these objects as having flown into a cloud, illuminating the entire cloud in an extremely magnificent sight.

At 1800 hours on 9 September 1976, Hu Suisheng [5170 6659 3932] and some comrades from the No 2 Chemical Plant in Jiangxi Province were listening to a broadcast at the main entrance to his home on Huancheng Xilu, Yichun City, Jiangxi Province. Suddenly they looked up to see a silvery flying object in the air at a 60 degree angle of elevation that was shaped like a pair of cymbals connected together and revolving on its vertical axis perpendicular to the lower line of the setting sun. It constantly spurted out a silvery vapor, and it was at an elevation of approximately somewhat more than 2,000 meters. It flew at a fairly rapid speed from the east toward the northwest and disappeared in a distant mountain valley. The period of observation totalled 5 minutes. There were many witnesses in the streets at the time, and everyone discussed the event excitedly but without being able to explain it.

At 2130 hours on 9 September 1979, Shao Shengnan [5135 3932 0589], and Shen Ziran [3088 5261 3544], technicians at the People's Dayuan Farm in Jianli County, Hubei Province sighted a round flying object in the southwestern sky at a 70 degree angle of elevation. It was emitting a red and yellow ray of light and the forward part of it was circled with blue. Its brightness was about that of a 1 or 2 star; its visual diameter was about 30'; it trailed an awl-shaped tail; its length was four times the diameter of its round head; and its height was estimated at 1,000 to 2,000 meters. It flew rapidly and soundlessly from the northeast toward the southwest. They immediately called two people out to take a look at it. When they saw it only at about a 15 degree angle of elevation, suddenly it changed to a right angle and slowed speed, and then at an included angle of about 10 degrees to the horizon, it changed flight direction to fly toward the southeastern horizon where trees blocked the view and it disappeared. The period of observation was about 1 minute.

At 2140 hours on 9 September 1979, an outdoor movie was being shown at the Hunan Diesel Engine Plant at Zhangmuqiao, Changde County, Hunan Province when suddenly a commotion broke out in the audience, which frantically turned their heads to look upward at the sky in amazement. Lo Xuezhi [5012 1331 4249], a functionary in the plant's political department turned his head to look, seeing an object in the sky to the west at about 1,500 meters. It was oval shaped in appearance and emitted a powerful red and yellow light that was brighter than the full moon. The head of the object was orange-red, and it trailed a bright tail which seemed to be emitting a gas. It flew silently and parallel to the ground from the north toward the southwest, disappearing after 3 minutes. Lo Xuezhih used the 2.5 power binoculars he was carrying at the time to examine the object carefully, and wrote an exhaustive report. Changde County is 145 kilometers from Jianli County. On that night, the sky was clear and cloudless. This object might possibly have been the same object as the object in the example next above. If so, it may be inferred that its flying speed was at least 850 kilometers per hour, and if you take into consideration the reduction in speed to change direction, it must have actually been even faster. In addition, according to Lo Xuezhi's estimate, the visual diameter of the long axis was greater than 2 degrees, so at a distance of 1500 meters, its lineal angle must have been more than 50 meters.

Disc shaped unidentified flying objects sometimes also appear at high altitudes. One summer night in 1965, when Song Jiandong [1345 1696 2639] of the broadcasting station in Jingan County, Jiangxi County was looking at the stars, (Song was on a temporary duty assignment in Beijing at the time in the courtyard at 20 Shangsitiao, Chongwen District), when unexpectedly he sighted a small bright point of light moving across the night sky from west to east at a speed similar to that of most artificial satellites. Soon afterward he discovered that a rather large point of light had appeared behind the first one. After 10 seconds or so, the distance between the two points of light gradually narrowed, and Song Jiandong immediately aimed his homemade astronomical telescope at them. He saw that the large point of light appeared oval in shape and emitted green light. The small point of light remained in the shape of a dot. When he again used his unaided eyes to look, the large point of light suddenly collided with the small point of light at a speed several times what it had been. The two moved now left now right in pursuit of each other as though playing. As the two points of light almost collided, they both disappeared at the same time. Song Jiandong looked, his eyes astounded and his mouth agape, and recorded the event immediately thereafter. He felt they were positively not meteorites or artificial satellites.

In still another report, an unidentified flying object appeared at low altitudes, frequently shining a powerful beam of light toward the surface of the earth. In late January 1979, an unidentified flying object of ordinary shape stopped suspended above a highway in Training County, Fujian Province shining a blinding light downward and scaring in all directions three women from Zhukou Commune who were going to market before dawn. In February of the same year, an extremely bright flying object darted across an airfield in Shanxi "lighting up half the sky." Similar reports have also come from Jiangsu and Hubei provinces. At 0930 on 1 July, Liu Baoren [0491 1405 0088], Tian Qing [3944 7230], and Zhao Yanyan [6392 3601 3601] of the Institute of Electronics, Chinese Academy of Sciences, were waiting for a bus at the Qijiahuozi bus stop in the northern suburbs of Beijing. They sighted a ball shaped flying object in the sky with an estimated diameter of 10 meters. From the bottom of it projected a tail that looked like a stick that was about 5 meters long, and hung straight down. It flew from due southeast toward the northeast against the wind at the speed of most airplanes and without noise of any kind. Inquires made by the witnesses revealed that on that day no meteorological or atmospheric testing balloons had been released by the Beijing Observatory or the Beijing Municipal Environmental Protection Bureau. Only the Beijing Meteorology Station had released a meteorology balloon, but the balloon was white, while the flying object appeared to be dark gray in color. The times did not jibe either.

The second category are huge, long unidentified flying objects. They rarely appear.

At 2040 hours on 23 October 1978, a huge, long unidentified flying object appeared in the sky over a certain airfield in Gansu Province. It carried two bright lights in front and at the tail, and flew from east to west. The speed of movement of this object was not astounding, but according to a report from airforce pilots and ground support personnel who had been watching an outdoor movie at the airfield, its visual diameter was 30 degree to 35 degrees. It covered half the sky, causing extreme astonishment. At the estimated height of 6,000 to 8,000 meters that they gave, its length must have been greater than 1,000 meters.

The third category of unidentified flying objects are in the shape of a spiral nebula. Composed of a brighted lightly central core, and revolving arms composed of small points of light radiated by the core, the volume may be enormous.

At 2300 hours on 26 July 1977, Zhang Zhousheng [1728 6650 3932] of the Yunnan Observatory observed an unidentified flying object of this type with an apparent visual diameter 5 degrees in extent in Chengdu, Sichuan Province. He made a record and conducted investigations, discovering that for 180 kilometers north and south many people had seen this unidentified flying object at the same time. Additionally, Yang Fozhang [2799 0154 4545] of the Chengdu Geology Institute, and Qian Ruhu [6929 3168 5706] of the Shanghai Ruijin Telecommunications Component Plant saw similar unidentified flying objects in Chengdu and in Anhui respectively.

We have made the following preliminary analysis of these unidentified flying object phenomona, which we provide for everybody's consideration.

(1) Prior to 1978, "flying saucer" incidents were virtually unheard of in China, but numerous reports based on data from prior to this time have appeared. Additionally, those giving eyewitness accounts include scientists and technicians, pilots, cadres, and teachers, and in most cases tens or thousands of people witnessed them at the same time. In the course of inquiries, ample witnesses have been provided. Consequently, we feel all the phenomena reported are substantially reliable and were actually experienced by the eye witnesses. Possibilities that they were fabricated, imagined, or were rare psychological phenomena are not great.

(2) On the basis of existing scientific knowledge, some reports may be explained by already known physical phenomena or already known rarely seen phenomena such as meteorites, fragments of man made aerial navigation devices, atmospheric whirlpools, balloons, the effects of atmospheric electrical discharges, ball shaped lightning flashes, and flashes of light from the earth preceding an earthquake. But explanation of some reports in terms of already known phenomena is either difficult or extremely farfetched, as for example, the strong light emitted by the flying objects and their mobility at high altitudes. Toward these phenomena, we must adopt an objective attitude of respect for facts and strive to use existing scientific knowledge to explain them, without brushing aside the possibility of phenomena not yet known, and conduct serious scientific observations and study without any preconceptions. As regards hypotheses about UFO's being related to extraterrestrial or terrestrial creatures as yet unknown, we must also accept those parts that are credible and consider them without totally denying them altogether.

(3) Most of the cases reported were not only similar in form and characteristics to reports from abroad of UFO's, but there also seems to be a rather extraordinary correlation in the times of events. Between 1971 and 1973, the United States and the United Kingdom experienced large numbers of eye witness accounts, and in China the number of reports showed a small surge as well. On 18 September 1976 in Tehran, Iran, an airforce Phantom fighter aircraft and a UFO had a combat encounter that raised a furor, while during this same time, the number of reports increased in China. During the summer and autumn of 1977, there was a case of UFO's in various places in Europe, and the number of reports in China were also fairly numerous. For example, Yuan Chenxin [5913 2182 2450] of the Institute of Paleoanthropology of the Chinese Academy of Sciences sighted a disc shaped unidentified flying object in the forest area of Shennongjia in Hubei Province. Fang Qing [2455 7230] and others from the Shanxi Teachers College observed an orange-red saucer shaped unidentified flying object at Taiyuan. On 21 October 1978, an incident took place in Australia in which a UFO caused the disappearance of an airplane, and two days later in China a correspondingly huge unidentified flying object of similar characteristics was observed. In early 1979 in New Zealand, storms broke out everywhere and there were corresponding reports inside China. On 17 August, a Japanese pilot photographed a UFO, and 2200 hours on 21 August, Beijing student Wang Jianmin [3769 1696 3046] observed in the skies over Beijing a blue disc shaped unidentified flying object flying in a complex path, now fast now slow, and able to stop suddenly. On the morning of 10 November, Fan Da [5400 6671], a cadre at Danzhu Commune, Pingnan County, Guangxi Province observed from the fourth floor of a building a silvery oval shaped unidentified flying object that constantly spurted forth some substance as it flew. The next day an incident occured in Spain in which a UFO forced the landing of a passenger jet aircraft.

(4) By comparison with some events reported abroad, the substance of reports currently being received in China is rather pedestrian. For example, there have been no instances in which unidentified flying objects have caused power outages or blotted out communications. There have been no photographs or movies taken, or material evidence left behind. There have been no cases of peril to humans or to social order. There certainly have been no cases of "flying saucer men." Inasmuch as most flying objects have not outstandingly exceeded the flying ability of man-made flying objects, it is not impossible that some of them have been manmade objects manufactured for special purposes.

Owing to the limitations of certain conditions, and because quite a few reports have contained no precise dates or were recorded unscientifically, their value has to be discounted. Among the people there are possibly numerous incidents of unidentified aerial phenomena awaiting our investigation and analysis. We hope that more aficionados will join in this work, and when they have sightings that they will get in touch by sending a letter to Cha Leping, Department of Space Physics, Wuhan University, Wuhan.

9432
CSO: 4008

EYEWITNESS ACCOUNTS OF UFO SIGHTINGS PUBLISHED

Harbin KEXUE SHIDAI [SCIENTIFIC AGE] in Chinese, No 5, Oct 1980 pp 5-7

[Article by Jin Tao [6855 3947]: "Sightings of Flying Saucers in China"]

[Text] Not only has a stream of reports of flying saucers come out abroad, but even in China reports of flying saucers have begun.

The excerpts from letters printed below are reports of firsthand observations for which we express our sincere appreciation to the reporters. Do flying saucers exist? Are they flying objects launched by superior forms of life on other celestial bodies in our galaxy? We currently have no way of replying, but this does not stop us from studying and collecting clues no matter how tenuous they may be.

On 24 September 1979, a report was received from Yang Xiusong [2799 4423 2646], teacher at a supplemental school in Tianjin's eastern suburbs:

It was the autumn of 1943, possibly a day in September at some time after 1900 hours in the evening at my native home in Qingxian. I was enjoying myself in the courtyard when suddenly something flew across the sky from east to west shining white light, but the light wave (the area covered) was not large. Its center seemed like a saucer "revolving around a fixed point" in the sky. When I saw it passing overhead, I ran up to the roof of the house at once to watch it, but it disappeared in about a minute. Later on I heard that it had landed somewhere. I think I was not the only one to see it at that time, and later on there was a lot of discussion about it, and it was said to be a new weapon that Japan had invented.

On 25 September 1979, a report was received from Wang Xue'an [3769 1331 1344] of the Burmese Language Unit of the Beijing Foreign Languages Bureau.

Around 1900 or 2000 hours on the evening of 18 September 1971, before the sky had entirely darkened and before the moon had come out, and not long after the students from Ji County in Hunan Province who were attending the May 7 Cadre School at the Foreign language Bureau in Beijing had eaten, everybody was in his room, some studying, some reading newspapers, some writing, and some chatting among themselves. Since I had nothing to do, I walked out the main entrance of the dormitory only to suddenly discover at a distance of about 2,000 or 3,000 meters up in the sky a huge lighted wheel slowly revolving in a clockwise direction while moving forward. After I shouted, the people in their rooms came flying out to watch. Unfortunately, when

I first discovered the lighted wheel, it had already passed over our cadre school and was located at a 60 to 80 degree angle to it. It headed in a northwesterly direction away from us and slowly floated away. This great flying wheel assumed the form of a smoke cloud, and it looked a little like a spiral nebula in pictures of heavenly bodies. It emitted a yellowish light, but I heard no sound. The center of this huge lighted wheel seemed thick while it became gradually thinner toward the edges. Its speed of turning was quite slow, but its speed of forward motion was relatively fast. I observed it for about one minute until it graudally disappeared across the horizon to the northwest. All 10 of us kept looking at this extraordinary phenomenon until we could see it no longer.

On 27 September 1979, a report was received from Liu Taiquan [0491 3141 1557], a graduate in the 79th class of No 2 Middle School in Chengyang Municipal Middle School in Shaanxi Province:

On 23 October 1977, I wandered the streets and lanes listening to adults chatting. It was almost dusk when suddenly someone pointed at the sky and said: "Look! What is that?" Everyone looked up at the sky. We saw only a globe shape (dark yellow in color) spinning there and moving forward vary rapidly. It remained within our sight for only a minute or so (though we watched until it disappeared). Out of curiosity, I recorded the incident in my middle school arithmetic book, and this is what I wrote. "At 6:45 pm on 23 October 1977, the direction of flight was from north to south."

On 29 September 1979, the Shaanxi Branch of the Chinese Academy of Sciences forwarded a report from Wang Yongjun [3769 0516 6511], third year student in the Department of History at Shaanxi Teachers University:

During summer vacation this year on an afternoon in early August (between 1600 and 1700 hours, the sky was dark blue and utterly cloudless when my mother and I cleaned up some wheat that had been left out for sunning. Suddenly we discovered coming directly out of the west a basically globe shaped (its edges were irregular) thing like a fireball, revolving and flying toward the southeast. It was yellow, red and white in color, but yellow predominated with red next, and finally white. The center of the globe had the shape of a tongue of flame that constantly changed, but the tongue of flame did not extend outside the body of the globe. It flew forward at an even speed (faster than an airplane but slower than a meteorite) without stopping and without any apparent increase in altitude. The object flew for about a minute until it suddenly disappeared without trace in a southeasterly direction. The object was larger than a wash basin but smaller than a sieve.

Point of observation: Shunling Second Brigade, Dizhang Commune, Jianyang City.

On 28 February 1979, a report was received from Wang Zhen [3769 7201], second year student in the Department of Chinese Language at Gansu Teachers University:

It was probably one day in August 1977 when I was at Baidunzi in Jingtai County, Wuwei Prefecture, Gansu Province. At the time, I was a trade union cadre in the Yinzhen Textile Mill in Gansu Province, and I had just arrived together with a group of employees from the mill, at a farm operated by the mill where we were going to join in the wheat harvest (at approximately 104.5° E, 37.5° W.)

That evening a movie was being shown in a unit at the southern edge of our farm, and many of the people from our farm went to see it. It was already quite late when I went (probably between 2030 and 2100 hours). It was already dark and stars flickered in the sky. Visibility was excellent, and the open countryside stretched as far as the eye could see. I and two other colleagues walked along together, examining the magnificent star-studded sky as we walked. Since childhood, I have been quite fond of astronomy, and while a primary school student in Shanghai, I joined the astronomy section of the municipal youth science and technology guidance station.) Suddenly, the attention of all three of us was attracted by a marvelous flying object. Since it was so peculiar, everyone seemed frightened, held their breaths, and made not a sound. A very large flying object emitting a milky white strong light flew soundlessly over our heads, flying off to our right side at not too great a speed, going from north to south. Our first impression was that it was not far from us (the surface of the ground), because if most of the stars may be said to be as large as a "sesame seed," the flying object was as big as "a one-cent nickel coin" (or else if it was distant from us, it was extremely large). It was rotating (but I have forgotten the direction of rotation), and it had a power source that emitted light. The light was very bright but not eye-piercing. The light beam shone down in a whorl-like shape (like smoke rings) as the body of the flying objected revolved. Each ring came out in about 1 or 2 seconds. This flying object seemed to be multi-storied, because it did not look like a circular iron cake but rather like the cover for an enamel mug, and because it gave me the feeling that in addition to the light projected downward as it rotated, that the light from other small points of light were even brighter than that light beam. The entire flying object was shrouded in a vapor-like light that was a little less bright than the whorl-shaped light beams that shown down from the rotation, and the flying object was not flat.

Within about one-half to one minute, it disappeared over the horizon to the front of us (the south).

On 5 October 1979, a report was received from Wang Ziteng [3076 5261 7506], of the Athletic Commission in Handan Prefecture, Hebei Province:

One evening during the summer of 1958 at around 2000 or 2100 hours, I was in my hometown of Wangjiacun, Boyang County, Jiangxi Province. I was outside the main entrance to the courtyard enjoying the cool air, when suddenly I heard several housewives shout, "It's bad. It's a bad omen!" Some picked up vegetable knives, and some held sticks with which they beat on the bamboo bed in an effort to drive away the "monster"!

The "monster" was round in shape and able to emit red light and blue, and white colored light. Its speed of flight was not too fast, and it was, perhaps, somewhat more than 10 zhang high.....

On 6 October 1979, Li Hong [2621 3163] of the 205 team (Gaoling County, Shaanxi Province) of the No 2 Composite Prospecting Brigade of the headquarters of the State Geology Bureau reported:

In 1977, we were working in Luonan Prefecture in Shaanxi Province. It was probably toward nightfall in the middle of October (I can't remember the exact time, but I can find out if necessary). Many people had congregated in front of the stage to watch a play, when suddenly there appeared in the sky an orange-yellow, revolving, disk-shaped dlying object, which slowly moved from the northwest toward the southeastern horizon in the course of from one to two minutes. At Yongfeng, many fellow-villagers also came rushing out to look in response to shouts of alarm. After our team dispersed, it was said that some people in Gaoling had also seen this phenomenon, and quite a few people believe they had seen it.

On 10 October 1979, a report was received from Wang Baosheng [3769 1405 3932] at the People's Printing Plant in Baoji, Shaanxi Province:

In August 1977 while I was at Shujiagou, Miaochuan Brigade, at the foot of Wu Mountain in the Xinjie Commune of Baoji County, I saw a strange star. On the afternoon of this day just as night was falling, the sky was exceptionally clear; the heavens were filled with stars, and there were no clouds. Five of us including Li Donglin [2621 2639 2651], Huang Aizhong [7806 1947 1813], and Liang Zhike [2733 1807 4430] had just ringed the table to eat. When I raised my head, suddenly I saw a strange star fly over the tops of our heads, and I immediately excitedly told everyone to look. We saw only that it belched smoke and shot out tongues of flame as it rotated off to the south. This thing was about as large as a small basin, and it disappeared from view within about one minute.

On 14 October 1979, a report was received from Liu Genji [0491 2704 1015], worker at the transportation repair plant of the 71 Roadbed Construction Company, Tongzhou City, Shaanxi Province:

It was probably during the wheat harvest season of 1970 or 1971 in Chengguan Prefecture, Tongzhou City. (I can't remember for sure just when I went to live and work at the production team there). I and two other young men were on the road back to the production team after having delivered some vegetables to the procurement station. (It was already around 2100 hours). When I looked up at the sky over my head, there was a foggy kind of cloud that was very white and semi-transparent. The sky was clear at the time, and I didn't see the moon nor any other clouds. I had never seen such a semi-transparent misty cloud before, and I was very curious about it. As I pulled the two-wheeled cart along, I looked upward at it and told my buddies about it. After about 20 seconds, a wheel that looked like a globe emerged from it, which was about as big as the full moon when it first rises on the day of the mid-autumn festival. It was very bright and moved ahead slowly and rotated upward. It then stopped at what I would guess was about 200 meters away and was slowly enveloped by a semi-transparent misty cloud and became no longer visible. Along the line of its flight a mist lingered such as comes out of a jet airplane exhaust. My guess about its height is that it was substantially the same as the height of the moon when it comes up. We walked for about two li, and it also rotated away behind the western hills like the moon, maintaining the same speed throughout. If it had not spurted out a misty cloud, I might have supposed that it was the moon moving faster than usual.

After returning to the production team and unloading the cart, I went out to the wheat fields to look around. There were four or five people there including the team leader. I asked the team leader whether he had seen the situation in the sky, and the team leader said that they had all seen it. It has risen from the foot of the eastern hills and was gleaming when it first rose and as big as a dipper, but they didn't pay any attention later on.

9432
CSO: 4008

APPLIED SCIENCES

TELEVISION RECEIVER FOR BROADCAST SATELLITES DEVELOPED

Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese No 2 Jun 1980 p 109

[Article: "The 12 GHz Television Receiver for Broadcast Satellites"]

[Text] In coordination with the development of our nation's television broadcasting via satellite, the Nanjing Solid State Devices Research Institute used the institute's own instruments to successfully develop and to produce a small batch of all solid state television receivers for broadcast satellites. The first batch of sample receivers have successfully received simulated broadcasts in September of 1978. In 1979, they were fully inspected and examined and passed technical inspection by the ministerial level authorities.

The first such highly sensitive television receiver developed by the institute has an antenna with a diameter of 3.5 m, including a parametric amplifier, eigen oscillator, lower frequency changer and front and middle amplifiers, outdoor reception units with a dimension of 265 x 240 x 81 mm^3, including a second frequency mixer, middle amplifier, modulator and indoor reception unit for the low frequency circuit with a dimension of 455 x 530 x 169 mm^3. The receiver's noise coefficient $<$ 3 dB and it has 5 channels. The institute is also researching and developing receivers with antennas of different diameters (ϕ 5 m, ϕ 1.8 m, ϕ 1.2 m, and ϕ 0.8 m) and different methods of reception. (For example, using the field effect transisterized amplifier as the front end for low noise) to further lower cost and to adapt to the different needs of the users.

At present, the electrical functions of some of the components used in the receiver are as follows: The parametric amplifier is used as the front amplifier, its noise coefficient $<$ 3 dB, its gain $>$ 15 dB, band width $>$ 180 MHz. The solid state effect oscillator is used as the eigen oscillator, its output $>$ 20mW, the frequency/temperature coefficient is 0.02 MHz/C° (−40°C to +70°C). The frequency mixer is used as the lower frequency changer, its noise coefficient is 4 to 5 dB. A photograph of the actual receiver is shown below. [not reproduced]

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APPLIED SCIENCES

YIELD OF 4K N-MOS DYNAMIC RAM CHIPS OVER 20 PERCENT

Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese No 2 Jun 1980 p 110

[Article: "The Yield of the 4K N-MOS Dynamic RAM Chips Is Over 20 Percent"]

[Text] The N-MOS 4096-bit dynamic random access memory (RAM) developed by the Semiconductor Institute of the Chinese Academy of Sciences used advanced N groove silicon gate isoplanar technology and single tube unit circuitry. The scale of integration is 10875 components/chip and the productive yield of the tube core is over 20 percent.

To improve the scale of integration, shrink the area of the chip and improve the function of the circuit, the circuit was simplified, and more profound studies were conducted in each single technology. The technology of precision processing was studied to shrink the dimensions of the horizontal photoetchings, to reduce the longitudinal thickness of the thin layer and effectively solve the problem of type inversion of the N groove field area and the thin gate area. The technique of injection of ions into the field was used and the planar technique of using silicon nitride to mask selective oxidation, oxidation using the hydrogen chloride gate, chemical gas phase sedimentation of multicrystalline silicon, and plasma erosion techniques. In joining the individual technological processes, we sought a more rational technological process. Samples were made of the three types of circuit board diagrams designed by ourselves. One of them is a single clock TTL compatible 4K MOS dynamic RAM chip whose structure is shown in the accompanying diagram. [not reproduced] The sample's smallest line width is 5μ m, the effective groove is 6 μm in length, the unit area is 24 x 57μ m^2, the chip has an area of 3.5 x 4.5 mm^2. The data access time is 350 ns, work loss is 500 mW. Under 70°C, retention time can reach a maximum of 200 ns.

An important factor affecting the percentage of production is the percentage of perfection of each step of each single technology. For this, the institute spent more time to study the stability of each technology, inspected the quality of the original material, strictly controlled each operational procedure and used a scientific management system, improved the ultra-sanitary environment and strengthened inspection of the quality of the techniques. In the course of production of ten batches of chips, the average tubal chip production rate reached above 25 percent.

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CSO: 8111/0200

APPLIED SCIENCES

HCP SYSTEM FOR AUTOMATIC COMPILER PROGRAMS DESCRIBED

Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese No 2 Jun 1980 pp 106-108

[Article by Liu Ouye [0491 5665 2814]: "The HCP System for Automatic Compiler Programs"]

[Text] (Abstract)

This article briefly describes a kind of descriptive language TL and the HCP system that generates this language. It can be used to generate automatic compilation programs for many computer languages.

1. Introduction

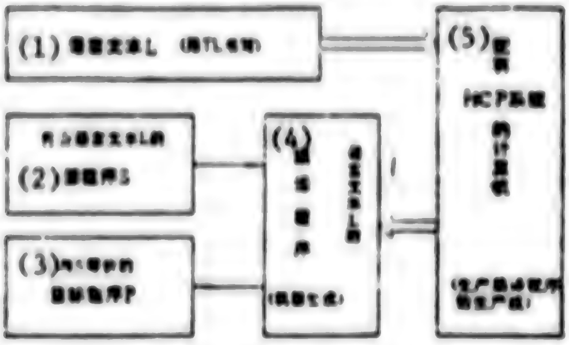
At the end of the 1960's, compilation theory had already developed to a mature stage but the designing, writing and compilation of programs were not mechanized and the problem has not been solved yet. Domestically, most compilation programs for computers are still being written in machine language or assembly language. Each language used required writing a corresponding compilation program. The period for development (from establishing the text, designing the assembly block diagrams and programs to testing on the machines, debugging and finalization) is relatively long. Therefore, to provide one computer the capability of handling many languages involves high costs and the development period is very long.

In recent years, there has been great success in using high level languages (such as PASCAL) to write compilation programs. But providing a compilation program for a system language beforehand is still necessary. A definite amount of work has to be done to generate or transplant the compilation program, and translation via this kind of a linguistic system reduces the efficiency of the compilation program. At present, although these methods have all had some successes, their efficiency is not ideal. For this, we studied and developed the following plan to automatize and mechanize the generation of compilation programs, shorten the development period and to retain the efficiency of the target programs.

2. Description of the Design Philosophy and Function

We designed a king of descriptive computer language--the language TL as the text of the computer language and the HCP level compilation system for generating TL.

If we hope to obtain the compilation program of a certain computer language L, all we need to do is to write the text of the language L according to the rules of TL (including syntax, semantics and limitations). The HCP system accepts the text of the language and automatically generates corresponding compilation programs. The generated compilation program can accept any source program S compatible with the text of the language L, and produces the target program P equivalent to S, as shown in Figure 1.



[illegible] HCP[illegible]

Figure 1 Illustrative diagram of the function of the HCP system

1. Text of the language L (written in TL)
2. Source program S that is compatible with the text of the language L
3. Target program P that is equivalent to S
4. Compilation program of the text of the language L (machine generated)
5. Computer equipped with the HCP system

(Production line that produces the compilation program)

As everyone knows, a compilation program is divided into syntax and semantics, the theory of compilation of the syntactical part is more mature while the semantic part is directly related to the machine, and it is also a major part that affects efficiency. Therefore, this plan also divides the text into two parts, syntax and processing of syntactical mistakes, and semantic subroutines. The two parts are separately processed. The syntax and the related linguistic messages that should be inserted are written according to the rules of the text of the language TL. The analytical program of the syntax of the compilation program is generated by the HCP system. At present, the semantic subroutine is written in assembly language or machine commands. The HCP system inserts the semantic subroutine into each comprehensive scanner.

The syntactical description of syntactical analysis generally uses the BNF memory method.* It has a wide scope of describing all syntax and the form is strict.

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*J.W. Backus, The Syntax and Semantics of the Proposed International Algebraic Language of the Zurich ACM-GAMM Conference, Proc. International Conf. on Information Processing, UNESCO, 1959, pp 125-132.

Yet, this method cannot reflect the computational method used and the problems of ambiguity and left recursion occur. The syntax of TL we propose is a high level language that describes the process of syntactical analysis. It reflects the analytical method of computation of the recursive subroutine. The form is similar to the syntactical diagrams of PASCAL, a string of symbols written according to linguistic rules. As long as the language can satisfy the syntactical rules of TL, the text of the language can be written in the text of the language TL. As soon as the text of the language is written out, the problems in syntax described above will automatically be eliminated. At present, a majority of the computer languages can be written out using the TL syntax. The syntactical rules of TL is a kind of high level language, it is clear and simple. These characteristics have made it convenient for writing, revising and debugging the text of the language.

3. Efficiency and Period of Development

This developmental work is still in the experimental stage. The HCP system requires practical testing for further enrichment, perfection and improvement.

We used the HCP system to generate a proofing system of the proofing language CPVL of equivalence formulas in mathematical logic. The period of development was 13 man-hours. The time required by the TQ-16 computer to generate the CPVL system using the HCP system was 12 seconds. The proofs of the 69 equivalence formulas in the book by J.P. Tremblay et al entitled "Discrete Mathematics and Its Application in Computer Science" were done in 10 seconds, showing 68 equivalence formulas were correct and one equivalence formula was incorrect due to printing error. This shows that the function of the proofing language CPVL system for formulas as generated by the HCP system is correct.

We also used the HCP system to relatively quickly generate an assembly program for the TQ-16 computer. The time for writing the text of the language and debugging was 11 man-hours. The HCP system operating on the TQ-16 computer generated the assembly program in 7 seconds. The time required to translate the entire semantic program of the text of the language into the target program using the assembly program thus generated was 12 seconds. The quality of the target program was equal to the hand written program.

Because the semantic subroutine was written in machine language or assembly language, the quality of the compilation program itself and the quality of the target program after compilation are both determined by the quality of the semantic subroutine. Thus, the use of the HCP system to generate the compilation program can produce the same quality as a hand written compilation program.

This is because the compilation program of all languages whose text can be written according to rules of TL can be generated using the HCP system as the tool. In this way, the period for developing the compilation program is equivalent to the period for developing the text of the language, and the developmental period is greatly shortened, and a way of mechanizing software has been provided.

Although this work is still in the experimental stage, it can be seen from the results of preliminary experiment that it is an important way to solve the problems of automation of writing compilation programs.

All comrades of the HCP group participated in the developmental work. We also received a lot of support from such units as Fuzhou University, the National Computer Administrative Bureau, the Computer Institute of the Chinese Academy of Sciences, Nanjing University, the 625 Institute of the Third Ministry of Machine Building, the Design Institute for Industrial and Civilian Construction of Fujian Province. Comrade Zhong Cuihao [0112 5488 6275] edited this article. Thanks to all.

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CSO: 8111/0200

APPLIED SCIENCES

INFORMATION ON DYL-1300, 77-1 MICROCOMPUTERS PRESENTED

Beijing DIANZI XUEBAO in Chinese No 1, Mar 80 pp 98-99

[Text] Using its newly-developed multielement logic circuits, the Institute of Semiconductors, Chinese Academy of Sciences, successfully assembled the DYL-1300 microcomputer, with a speed of 500,000 operations per second and a word length of 16 bits, in September 1979. This model uses microprogram control, and the overall capabilities of its instruction set are the same as those of the Chinese-produced DJS-130 minicomputer. Current test results indicate that the execution speed of all of the instructions is faster than that of the DJS-130. More than 50 hours' continuous normal operation has showed that the newly developed multielement logic has successfully passed the test of incorporation into the machine. The article "A New High-Speed Integrated Logic Circuit" in No 2, 1978 of this journal and the article "A Multielement Logic Circuit 12-Bit High-Speed Carry Generator" in the present issue introduce the developmental results regarding this type of circuit. The illustrations [not reproduced] show the DYL-1300 microcomputer and a book-type circuit assembly.

The Shaanxi Institute of Microelectronics has used an LSI circuit which it produced to successfully develop a new 77-1 model microcomputer in 1978. The computer's technical parameters are: basic word length 16 bits; can execute a maximum 64-bit length operation; basic instruction set, 23; can carry out multiple bit length operations; uses microprogram control technology and 100 microinstructions; main frequency 50 kHz, microcommand operating cycle 2 microseconds; main storage uses n-channel silicon gate MOS storage (RAM 1 kbyte, ROM 4 kbyte, both expandable); uses direct, relative, indirect and stack addressing; has its own assembler language and is provided with some external peripherals. Controls a typewriter, optoelectronic output device, printer, stroke-type keyboard, flat-plate plasma display terminal and the like. Can be used in small-size scientific computations, process control and the like.

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CSO: 8111/0203

APPLIED SCIENCES

INCREASING SPEED OF MICROCOMPUTERIZED SEQUENTIAL MACHINES DISCUSSED

Beijing DIANZI XUEBAO in Chinese No 1, Mar 80 pp 51-59

[Article by Jiang Mingde [3068 2494 1795]: "Investigations Regarding Improvement of the Operating Speed of Microcomputerized Sequential Machines"]

[Text] Abstract: This paper proposes an approach to improving the operating speed of microcomputerized sequential machines on the basis of two fundamental concepts, namely that Mealy-type sequential machines have parallelism in computing the next internal state and the output state, and that a sequential machine can be converted into many autonomous machines. The resulting architecture is a duplex microprocessor system, whose operating speed is 1.4 times higher than for a simple microcomputerized machine approach. A sequential machine based on the M6800 microprocessor is used as a specific example of the above two concepts.

1. Foreword

The immense influence which is being exerted and will be exerted in computation and control technology by microprocessors (hereafter abbreviated MPU) is widely recognized. Sequential machines based on random logic (sequential circuits, sequential networks) can under certain conditions be replaced by "microcomputerized sequential machines,"[1] but there are inherent shortcomings, primarily the fact that at present the characteristic speeds of available MPUs are much lower than those of random logic.

This article investigates the possibility of using currently-available MPUs to increase the operating speed of microcomputerized sequential machines. We assume that the sequential machines in question are Mealy machines and are indecomposable.* Because they possess parallelism in calculating the next internal state and the output state, and can be converted into several autonomous machines, we have proposed the improvement of the operating speed of microcomputerized sequential machines. The architecture which we obtain is a duplex microprocessor system (DMPS). Its operating speed can be 1.4 times higher than that of a single microcomputer. In this article we use the M6800 system to organize such a DMPS type sequential machine, as a simple illustration of how the abovementioned two basic concepts are specifically implemented.

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*The assumption of indecomposability is not necessary; if it can be separated into submachines,[4] then each of the latter can be implemented with a DMPS as described here.

2. Basic Ideas

Let there be a Mealy-type sequential machine $M = < I, Q, \eta_0, F, \Phi >$,[2] where I is the input alphabet, Z is the output alphabet, Q is the set of states, $\eta^p \in Q$ (designated the initial state), and F and Φ are the transition function and the output function respectively:

$$\eta^{p+1} = F(\eta^p, \xi^p), \tag{1}$$

$$\lambda^p = \Phi(\eta^p, \xi^p), \tag{2}$$

where $p = 0, 1, 2, \ldots$; $\xi^p \in I$ is called the output symbol at the current moment p; $\eta^p \in Q$ is called the state at the current moment p; η^{p+1} Q is the state at the next moment p + 1; $\lambda^p \in Z$ is the output symbol at the current moment p.

Each element in the input and output alphabets is always in one-to-one correspondence with the values of a group of input variables x_r $(r = 1, 2, \ldots, l)$ and output variables z_s $(s = 1, 2, \ldots, n)$ on the basis of a fixed application. Accordingly, we can take the number of input and output symbols $|I|$ and $|Z|$ as 2^l and 2^n. The set of values of the input variable is a_r, where $a_r \in \{0, 1\}$; and the values of the output variable are b_s, where $b_s \in \{0, 1\}$; $a_l \ldots a_2 a_1$ and $b_n \ldots b_2 b_1$ are called the input and output states respectively.

Suppose that $|Q| = 2^m$; then the elements of the state set Q can be put in one-to-one correspondence with the values of a group of internal state variables y_t $(t = 1, 2, \ldots, n)$. The values of the internal state variable are q_t, where $q_t \in \{0, 1\}$; $q_m \ldots q_2 q_1$ are called the internal states.

As time advances, a Mealy sequential machine in state η^p receives input symbol ξ^p, proceeds to the new (next moment's) state η^p, and produces the output symbol λ^p.

The parallel computability of the two functions $F(\eta^p, \xi^p)$ and $\Phi(\eta^p, \xi^p)$ in formulas (1) and (2) reflects the fact that the Mealy-type sequential machine produces an output at the same time as it changes state. Accordingly we can use a parallel software driver function (Figure 1) to replace the sequential software driver function[1] as the first element in increasing the operating speed of the computerized sequential machine. Accordingly, it becomes necessary to use DMPS [duplex microprocessor system] architecture. The two branches of Figure 1 must be executed simultaneously, and should transition to the next state in a suitable manner.

We can view the sequential machine M as consisting of $|I| = 2^l$ autonomous machines,[2] whose input character set has only a single element, and whose output symbol set and state set are still Z and Q respectively, with the initial state still being η_0. This type of transfer function and output function are, respectively,

$$\eta^{p+1} = F(\eta^p, \xi_\alpha), \tag{3}$$

$$\lambda^p = \Phi(\eta^p, \xi_\alpha), \tag{4}$$

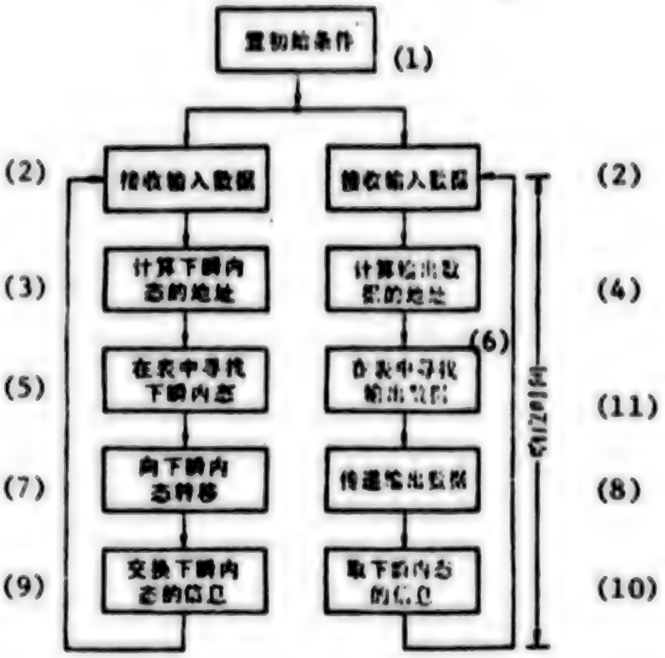

Figure 1. Parallel Software Driver Function

Key:

(1) Set initial conditions
(2) Accept input data
(3) Calculate internal state address for next instant
(4) Calculate output data address
(5) Search for next-moment state in table
(6) Look up output data in table
(7) Transition to next-moment internal state
(8) Transmit output data
(9) Exchange next-moment internal state signal
(10) Fetch next-moment internal state signal
(11) Response time

where the constant character ξ_* can be considered a symbolic parameter. Accordingly we can consider that the evolution of the sequential machine M with time will change during its operating process from one autonomous machine to another autonomous machine; this change is determined by the value of ξ_*. Accordingly we can convert the state transition table and output table[3] of sequential machine M into 2^ℓ subinternal state transition tables and 2^ℓ sub-output tables. Each pair of corresponding substate transition tables and sub-output tables describes one autonomous machine. The "transformation" discussed here can be applied to any sequential machine which is indecomposable in the usual sense.[4] In reality, each column (corresponding to an output symbol) in the flow chart which describes sequential machine M determines one autonomous machine.

When we use a DMPS to implement a sequential machine, the parameter $\zeta_{\star}$ in equations (3) and (4) can control (determine) from outside the system which autonomous machine should come into existence, by means of extremely simple random logic. Thus the MPU which is a part of the system need not receive input data, i.e. it need not process input data; its main function is to calculate the internal state transformations and outputs of the autonomous machines. This is the second factor used to increase the operating speed of microcomputerized sequential machines. A DMPS utilizing this factor will combine the use of the MPU and random logic. The random logic required here will be extremely simple.

3. A DMPS with Parallel Software Driving Function

A DMPS used to implement the sequential machine and parallel software driver function should have an architecture which uses tight coupling to carry out communication by the shared storage method. We use an M6800-based DMPS system as shown in Figure 2.[5] The parallel software driver function program and the sequential machine's internal state transition table and output table are all stored in memory.

Because a parallel software driver function's program has only two more instructions than that of an SOF (sequential driver function),[1] the range of sequential machines which this DMPS can implement is the same as for those considered in reference 1.

Table 1 shows the standard program for a software driver function, where program 1 is executed by MPU-1 and program 2 by MPU-2. For convenience in using a standard SDF program[1] as the basis for estimating the improvement of operating speed, the program in the table is organized in "standard instructions."[1]

The response time for the sequential machine implemented by the DMPS is

$$T_K \approx 5t_1 + 2t_2 = 9t_1$$

where t_1 expresses the instruction cycle required for an operation between working memory and working memory in the MPU, and t_2 expresses the instruction cycle for the MPU required for the operation in which the MPU accesses memory, $t_2 \approx 2t_1$. We already know that the response time required for a microcomputer to calculate a sequential software driver function is $12t_1$.[1] Clearly the DMPS respone time T_K is 25 percent shorter than the former, so that the operating speed is increased by 33 percent.

4. A DMPS Sequential Machine Architecture Which Further Increases Operating Speed

A DMPS sequential machine architecture which simultaneously utilizes both the first and second factors to increase operating speed is shown in Figure 3. The interface shown in the figure is used only for output; the two MPUs do not receive external input data; the input signal (x_1, ..., x_1) is selected at a suitable time by an output circuit of the external interface, and the random

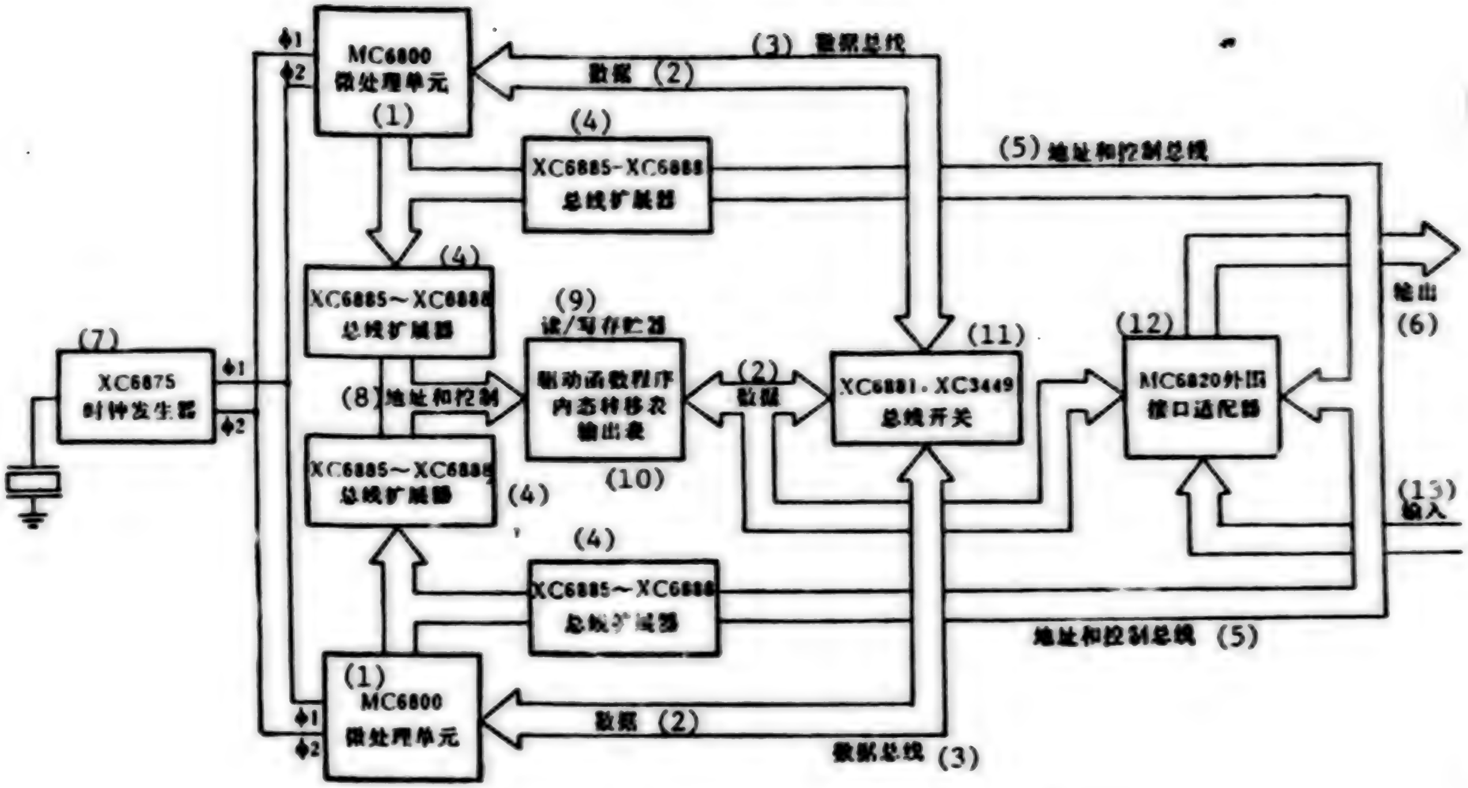

Figure 2. DMPS Implementation Using M6800 System

Key:
(1) MC6800 microprocessor
(2) Data
(3) Data bus
(4) XC6885-XC6888 Bus expansion unit
(5) Address and control bus
(6) Output
(7) XC6875 time generator
(8) Address and control bus
(9) Read-write store
(10) Driver function program, internal state transition table, output table
(11) XC6881, XC 3449 bus switch
(12) MC 6820 peripheral interface
(13) Input

Table 1. Standard Parallel Software Driver Function Program

程 序 1 (1)			程 序 2 (1)		
符 号 (2)	指 (3) 令	注 (4) 释	符 号 (2)	指 (3) 令	注 (4) 释
INP_1	MOVE I,ACC	I [illegible] (5)	INP_2	MOVE I,ACC	
	ADD W_1,ACC	W_1 [illegible] (6)		ADA M,ACC	[illegible] (7)
	ADD W_2,ACC	W_2 [illegible] (8)		ADD W_4,ACC	W_4 [illegible] (9)
	MOVE ACC,W_3	[illegible] (10)		MOVE ACC,W_5	[illegible] (11)
	MOVE I W_3,W_2	[illegible] (12)		MOVE I W_5,Z	[illegible] (13)
	STR M,W_2	[illegible] (14)		NOP	[illegible] (15)
	JMP INP_1	[illegible] 1 (16)		JMP INP_2	[illegible] 2 (17)

Key:
(1) Program 1, program 2
(2) Symbol
(3) Instruction
(4) Comment
(5) I is the converted input variable
(6) W1 contains base address of internal state transition table
(7) Add contents of "mailbox" M to accumulator
(8) W2 holds current internal state
(9) W4 holds base address of output table
(10) Fetch internal state transition table address
(11) Fetch output table address
(12) Move internal state
(13) Generate current output
(14) Store internal state in memory address M
(15) No operation; for synchronization with program 1
(16) Repeat program 1
(17) Repeat program 2

logic determines in which read-only memory the internal state table and output table of the current autonomous machine are located; the two MPUs execute the programs for the parallel software driver functions stored in read-write memory, and compute the internal state transition and output of the current autonomous machine.

The computation of the number of read-only memory required assumes a ROM capacity of 2^a, a number 2^m of sequential machine internal states, and a number of input variables. Accordingly there is a total of 2^{ℓ} autonomous machines, and the storage of each autonomous machine's internal state transition table and output table takes up $2^m + 1$ locations in memory* and the number of autonomous machines (internal state transition table and output table) which the ROM can hold, or the number of corresponding autonomous machines is $2^a/2^{m+1} = 2^{a-m-1}$. Accordingly we obtain

$$r = 2^{\ell}/2^{a-m-1} = 2^{\ell-a+m+1} \qquad (5)$$

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* These memory locations and those in ROM are byte-length.

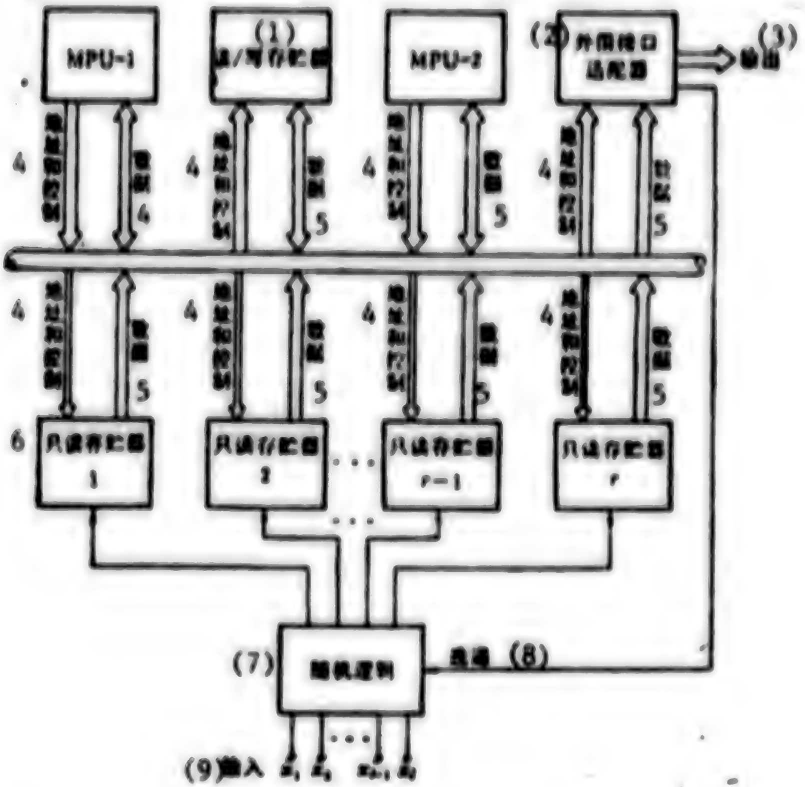

Figure 3. Architecture of DMPS Sequential Machine

Key:
(1) Read-write store
(2) Peripheral interface
(3) Output
(4) Addresses and control
(5) Data
(6) ROM
(7) Random logic
(8) Strobe
(9) Inputs

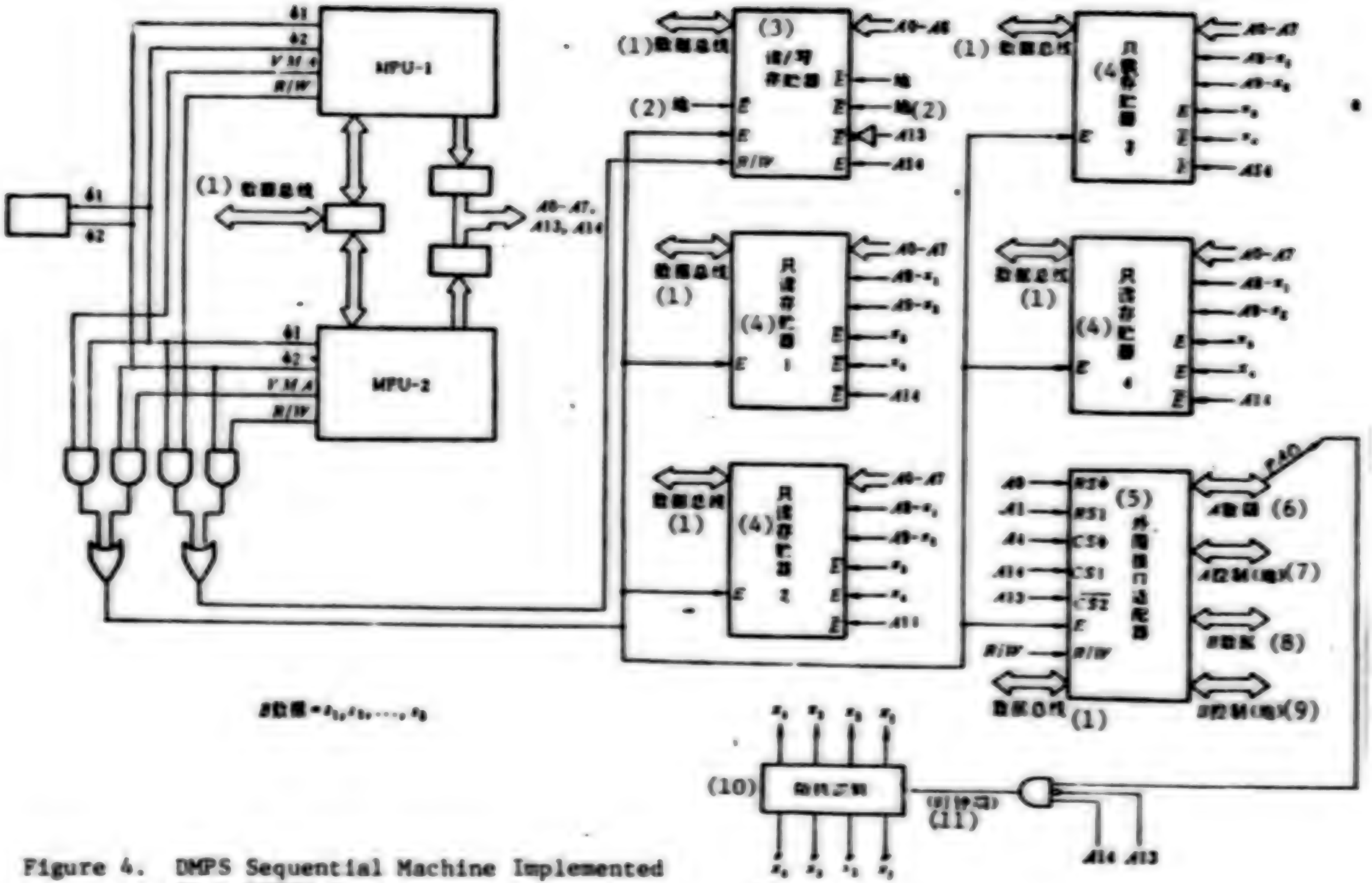

Figure 4. DMPS Sequential Machine Implemented
With M6800 System

Key:

(1) Data bus	(5) Peripheral interface	(9) B control (ground)
(2) Ground	(6) A data	(10) Machine logic
(3) Read-write memory	(7) A control (ground)	(11) Clock connection
(4) ROM	(8) B data	

In the above calculation we assumed that one internal state occupies one memory address (byte), so that its length m is not greater than 8, or that the number of internal states of the sequential machine is not greater than $2^8 = 256$; the number of output variables n is also no greater than 8. In cases where these limits are exceeded, we will need to allow for use of multiple words to store internal states or output states. But in real utilization, not all possible input states (input variable value groups) can appear under normal conditions, i.e. the number of autonomous machines may be smaller than 2^l (we assume it is less by e),[*] and accordingly the value r can be smaller than that defined in equation (5).

The speed of execution of the driver function program used in Figure 3 is related to the method by which the control signal for selecting the input is generated. The following three methods can be used:

1. To use one output line of the external interface (for example PA0 in Figure 4; see next section) we add one command to program 1 (of Table 2), so that a 1 is produced in that output line; then a corresponding command is added to program 2 so that that output line produces a 0. These lines are used as strobe lines.

2. An address line which fetches the value 1 in a special area of the peripheral interface unit (for example the unused A12 line in Table 4, while at the same time d in column 12 for the interface line of Table 3 is defined as 1) may be used as a strobe line. Although in this approach it is not necessary to add a corresponding instruction in the driver function program, the entire program (including the start section and the section which sets the initial conditions) must be carefully written in machine language. It is also possible to use several designated address lines, in which case random logic must be used to provide a gate.

3. Design an output line in the interface so that after the program implementation moves beyond the start and setting of initial conditions it will be set at 1. This line and the abovementioned special address line (or lines) are used together by means of an AND gate (if necessary a NOT gate), so that the output obtained can be used as a strobe line. In this approach it is not necessary to add a corresponding command in the driver function program, and it need not be meticulously designed in machine language.

Table 2 presents the parallel software driver function program needed for the architecture of Figure 3, using the M6800 instruction set; the section of the program setting the initial conditions (which will be given in the following section of this paper) sets the variable address registers for MPU-1 and MPU-2 at the proper "base" addresses[**] for the various corresponding internal state transition tables and output tables. Now we have programmed the driver function in the simplest form: other than the necessary JMP instruction, both programs 1 and 2 only retain two commands. The LDA A instruction in program 1 is needed for MPU-1 to transfer the internal state information to MPU-2, and the STA A instruction in program 2 is needed in order to produce the output. Because the response time of the sequential machine implemented by the DMPS in Table 3 is $t_1 + 2t_2 = 5t_2$, if we take the implementation time of the SDF program given in reference 1 as a standard, the response time is decreased by 58 percent, so that the operating speed is increased 1.4 times. If we use the SDF program in a sequential machine with $\ell + m > 8$*, because this requires double word length operations, under these circumstances we still use the driver function program of Table 2 (provided $m \leq 8$). Accordingly, in comparison, the speed will not necessary be increased by only 1.4 times.

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[*] These e input states can appear only when the input data differ. How to handle these data differences is a problem requiring further investigation, it will not be discussed here.

[**] We will see below that the "base" address is not an absolute address but is page-relative.

Table 2. Parallel Software Driver Function

程序 1 (1)			程序 2 (1)		
符号 (2)	指令 (3)	注释 (4)	符号 (2)	指令 (3)	注释 (4)
INP1	LDA A M1,X	M1 [illegible] A [illegible] (5)	INP2	LDA A M1,X	M1 [illegible] A [illegible] (6)
	STA A M1	[illegible] A [illegible] M1 (7)		STA A $4772	输出到PIA (8)
	JMP INP1	重复程序1 (9)		JMP INP2	重复程序2 (10)

Key:

(1) Program 1, program 2
(2) Symbol
(3) Instruction
(4) Comment
(5) Result of addition of M1 to variable address register is effective address, its contents are loaded into A
(6) M1 holds current internal state, accumulator A holds output
(7) Contents of A stored at M3
(8) Output to PIA
(9) Repeat program 1
(10) Repeat program 2

Example

In this section, using the architecture in Figure 3, we use a DMPS sequential machine from the M6800 series[6-9] to illustrate the principles of increasing operating speed discussed in this article.

Suppose that the sequential machine which we decide to implement has 2^7 states, 4 input variables and 8 output variables.

The internal state variable length $m = 7 < 8$, and accordingly the internal state transformation table and the output table both need only one 8-bit word.

---

* Reference 1 uses $j + n$.

Figure 4 gives a block diagram of the sequential machine in question. It uses two M6800 MPUs, one read-write store (128 x 8), 4 read-only memories (ROM) (1,028 x 4), and one peripheral interface. The main random logic consists of a 4-bit register, and its clock terminal is connected to PA0, $(\overline{A13})$ and (A14). To deal with the problem of synchronizing the two MPUs after they are started, we may also need some random logic.

The addresses of the main components of the sequential machine are shown in Table 3. The parallel software driver function program stored in the read-write memory is as in Table 4. The program sections which set the initial conditions (INI_1 and INI_2) are also executed by the two MPUs in parallel. After they are started, INI_1 is stored in MPU_1's program counter, and INI_2 is stored in MPU_2's program counter. The number of MPU cycles required for program sections INI_1 and INI_2 are equal; similarly, the number of MPU cycles required by program sections IMP_1 and IMP_2 are equal (13 MPU cycles). Accordingly, the sequential machine's response time is 13 MPU cycles.

Table 3. Sequential Machine Component Addresses

[illegible]	[illegible] (5)															
[illegible] [illegible] (1)	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
(2) [illegible]	d	1	1	d	d	d	d	d	d	x	x	x	x	x	x	x
[illegible] 1	d	0	d	d	x_4	x_3	x_2	x_1	x	x	x	x	x	x	x	x
(3) [illegible] 2	d	0	d	d	x_4	x_3	x_2	x_1	x	x	x	x	x	x	x	x
[illegible] 3	d	0	d	d	x_4	x_3	x_2	x_1	x	x	x	x	x	x	x	x
[illegible] 4	d	0	d	d	x_4	x_3	x_2	x_1	x	x	x	x	x	x	x	x
(4) [illegible]	d	1	0	d	d	d	d	d	d	d	d	1	d	d	x	x

Key:

(1) Component

(2) Read-write store

(3) ROM (1, 2, ...)

(4) Peripheral interface

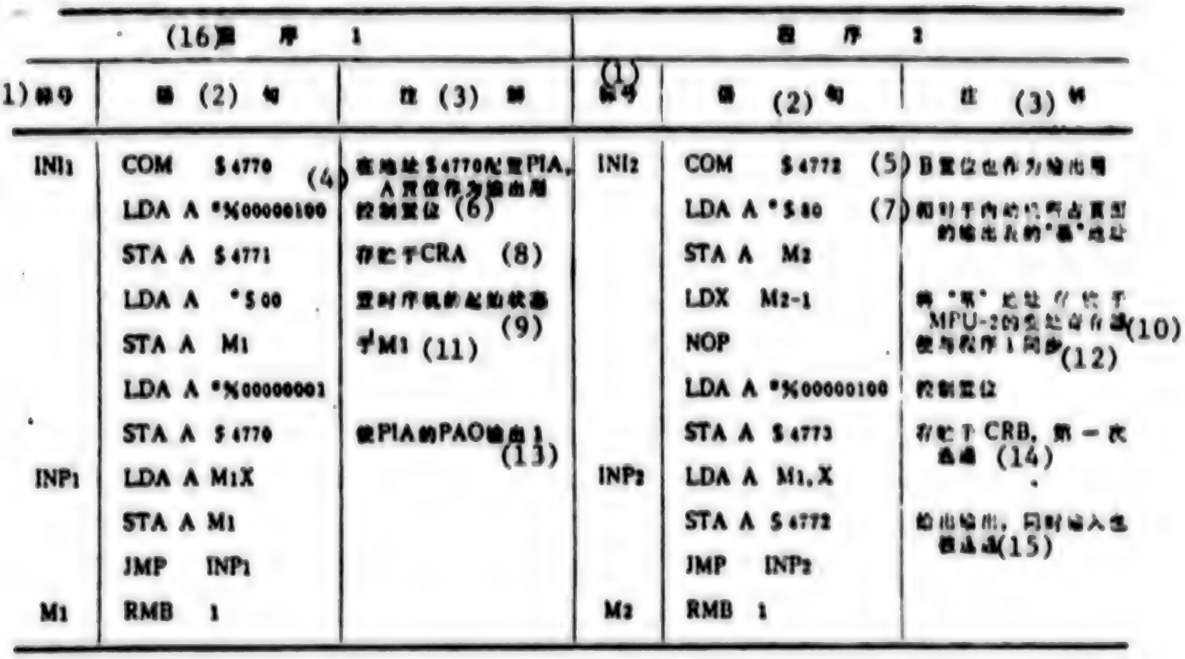
(5) Address

Note: d indicates don't care; X indicates variable address; input variables x, and x_2 are connected to ROM inputs A8 and A9; ROM actually has no relation to A10 and A11--the selection is made by output variables x_3 and x_4.

One ROM is equal to 4 autonomous machines. If an ROM is divided into 4 pages (256 words per page), then every page can store the internal state transformation table and output table of one autonomous machine.

The output data is output on side b of the external interface, while side a uses only one of its PA0 output lines to select the random logic components.

Ta' 4. Program of DMPS Sequential Machine Implemented With M6800 Series



(16)程 序 1			程 序 2		
(1)标号	指 (2) 令	注 (3) 释	(1) 标号	指 (2) 令	注 (3) 释
INI1	COM $4770	(4) 在地址$4770处置PIA, A置位作为输出用	INI2	COM $4772	(5) B置位也作为输出用
	LDA A #%00000100	控制置位 (6)		LDA A #$80	(7) 相对于自治机所占页面的输出表的"基"地址
	STA A $4771	存贮于CRA (8)		STA A M2	
	LDA A #$00	取时序机的起始状态 (9)		LDX M2-1	将"基"地址存放于MPU-2的变址寄存器(10)
	STA A M1	于M1 (11)		NOP	使与程序1同步(12)
	LDA A #%00000001			LDA A #%00000100	控制置位
	STA A $4770	使PIA的PAO输出1 (13)		STA A $4773	存贮于CRB, 第一次选通 (14)
INP1	LDA A M1X		INP2	LDA A M1,X	
	STA A M1			STA A $4772	给出输出, 同时输入也被选通(15)
	JMP INP1			JMP INP2	
M1	RMB 1		M2	RMB 1	

Key:

(1)	Symbol	(9)	Fetch sequential machine initial state
(2)	Instruction	(10)	Store "base" address in variable address register
(3)	Comment	(11)	In M1
(4)	Complement PIA at address $4770, a value used as output	(12)	Synchronize with program 1
(5)	B value used as output	(13)	Synchronize with program 1
(6)	Control value	(14)	Store at CRB, first strobe
(7)	"Base" address of output table relative to page on which autonomous machine is located	(15)	Produce output; input gated at same time
(8)	Stored at CRA	(16)	Program (1, 2)

6. Conclusion

Use of the ideas that a Mealy-type sequential machine has internal parallelism and can be converted into many autonomous machines to increase the operating speed of a microcomputerized sequential machine is feasible and effective. A DMPS coupled with a small quantity of random logic can speed up the operating speed of the sequential machine which it implements by more than 1.4 times, and can choose a relatively large number of internal states. The number of components required by this approach is comparable to the sequential approach in Reference 1, and basically it only adds 1 MPU and one register (or decoder).

A DMPS sequential machine made with the M6800 series can make full use of the extra address line, and coupling it with random logic is even more helpful. In case there are even more input variables, we can consider using decoders for the main random logic components.

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DYL 12-BIT HIGH-SPEED LOOK-AHEAD CARRY GENERATOR DESCRIBED

Beijing DIANZI XUEBAO in Chinese No 1, Mar 80 pp 1-8

[Article by Wang Shoujue [3769 1343 6030], Wei Shuming [7614 2579 6900] and Zheng Jie [6774 3381]: "A Multielement Logic Circuit 12-Bit High-Speed Carry Generator"]

[Text] Abstract: This article introduces a new-structure multielement logic high-speed LSI circuit, the DYL 12-bit high-speed carry generator (DYL 12-HSCG). It is made up of the basic DYL components, "linear AND-OR gates," is simple to manufacture and fast-acting, and has high manufacturing tolerances and a high acceptance rate. The article compares it with look-ahead carry circuits in other series to highlight the superiority of the DYL design. A complete test of the product capabilities with a random function tester and installation of the unit in the ALU of a DYL-1300 processor confirmed that the DYL 12-bit high-speed carry generator is reliable, stable and fast.

1. Foreword

In order to take our own route in new high-speed electronic circuits, we proposed in DIANZI XUEBAO No 2, 1978 a new type of multielement logic circuit (hereafter called the DYL). In the past year we have worked on the development of this series of circuits with its new structure.

As everyone knows, most machines use "positive AND-OR" logic, which is best typified by look-ahead carry generator logic. But the delay of this carry chain is the key to the operating speed of the central processor. This was our basic consideration in designing a high-speed carry generator.

2. Discussion of Approach

The general term of the n-th bit in a carry chain can be expressed as:

$$c_n = a_n b_n + (a_n + b_n)\, a_{n-1} b_{n-1} + (a_n + b_n)(a_{n-1} + b_{n-1}) a_{n-2} b_{n-2} \\ + \cdots + (a_n + b_n)(a_{n-1} + b_{n-1}) \cdots (a_0 + b_0) c_1$$

where a_i and b_i are the input data for the i-th bit, c_I is the external carry, and $i = 0, 1, 2, \ldots, n$.

A. First-Level Gate Delay: Completely Parallel Approach (Figure 1)

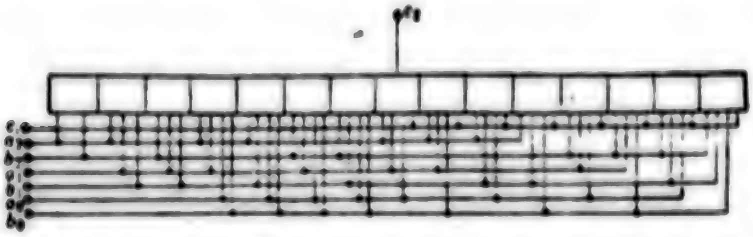


Figure 1. Level 1 Completely Parallel Carry Design, c_2

In theory, we can expand the formula for c_n and organize it with first-level AND-OR gates, thus implementing look-ahead carry generator logic, where the delay is only one level.

We can show this with the following data:

(1) Number N_m of gate circuits used. Because to generate c_n requires $(2^{n+2} - 1)$ AND-OR gates, the total number of AND-OR gates used for the n+1 digits between c_0 and c_n is:

$$N_n = \sum_{i=0}^{n} (2^{i+2} - 1) = 2^{n+3} - n - 5$$

If n = 11 (i.e. a 12-bit carry chain), then $N_{11} = 16,368$.

(2) The maximum number of input terminals for a single gate is n+2.

(3) The maximum input signal load will be borne by a_0 and b_0, and will be equal to $2(2^{n+1} - 1)$. If n = 11, then the maximum load borne by a_0 and b_0 will be 8,190.

(4) The total number of input terminals for the n-th bit is

$$I_n = (2 + n)2^{n+1} + \sum_{i=0}^{n} (2 + i)2^i$$

B. Second-Level Gate Delay: Parallel Carry Approach (Figure 2)

If

$$P_i = a_i + b_i,\ G_i = a_i b_i$$
$$c_n = G_n + P_n G_{n-1} + P_n P_{n-1} G_{n-2} + \cdots + P_n P_{n-1} \cdots P_0 c_I$$

From this we can derive the following:

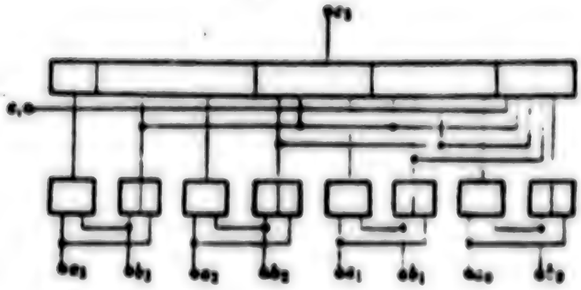


Figure 2. Level 2 Parallel Carry Approach, c_3

(1) Number of gate circuits

$$N_u = (n + 1)\ (5 + \frac{n}{2})$$

If $n = 11$, then $N_{11} = 126$.

(2) The maximum number of input terminals for a single gate is $n+2$.

(3) The maximum load L_i will be borne by P_i and will be equal to

$$L_i = (i + 1)\ (n + 1 - 1)$$

where i is the sequential number of the bit in question, and n is the total number of bits in the carry chain. When n is even, $i = n/2$, $P_i = P_n/2$; when n is odd, $i = (N \pm 1)/2$, and $P_i = P(n \pm 1)/2$. If $n = 11$, then the maximum load borne by P_5 and P_6 is 42.

(4) Number of input terminals for carry chain output gate. Because the AND-OR gate outputting c_n had $(n + 2)\ (n + 3)/2$ input terminals, the total number of input terminals of the AND-OR output gates from c_0 to c_n is

$$\begin{aligned} I_n &= \sum_{i=0}^{n} (i + 2)(i + 3)/2 \\ &= n(n + 1)(2n + 1)/12 + 5n(n + 1)/4 + 3(n + 1) \end{aligned}$$

and if $n = 11$, then $i_{11} = 454$.

As the above analysis indicates, the number of components, the size of the load, the power consumption and the complexity of the wiring of the above two approaches make them difficult to implement, but they give some guidance in regard to designing sequential-parallel look-ahead carry generators.

C. The Approach For the DYL 12-HSCG

Because full adders in the ALU are always in multiples of 4, we use the traditional grouping form, 4 bits to a group. A carry within the group uses a parallel output, while between groups we use carry propagation P_i and carry generator G_i in series-parallel connection to handle the generation of the last digit carry of each group, thereby simplifying the circuit structure and wiring, satisfying load conditions and decreasing the number of levels.

Below we use logical formulas to explain the basic approach of Figure 3. If we let c_0 through c_3 be the first group, c_4 through c_7 the second, and c_8 through c_{11} the third, and in addition in the following formulas we let $G_i = a_i b_i$, $P = a_i b_i$, $i = 0, 1, \ldots, 11$, then

$$\left.\begin{aligned} c_0 &= g_1 + p_0 c_I \\ c_1 &= g_1 + p_1 g_0 + p_1 p_0 c_I \\ c_2 &= g_2 + p_2 g_1 + p_2 p_1 g_0 + p_2 p_1 p_0 c_I \\ c_3 &= G_1 + P_1 c_I \end{aligned}\right\}$$

$$\left.\begin{aligned} c_4 &= g_4 + p_4 c_3 \\ c_5 &= g_5 + p_5 g_4 + p_5 p_4 c_3 \\ c_6 &= g_6 + p_6 g_5 + p_6 p_5 g_4 + p_6 p_5 p_4 c_3 \\ c_7 &= G_2 + P_2 G_1 + P_2 P_1 c_I \end{aligned}\right\}$$

$$\left.\begin{aligned} c_8 &= g_8 + p_8 c_7 \\ c_9 &= g_9 + p_9 g_8 + p_9 p_8 c_7 \\ c_{10} &= g_{10} + p_{10} g_9 + p_{10} p_9 g_8 + p_{10} p_9 p_8 c_7 \end{aligned}\right\}$$

where

$$G_1 = g_3 + p_3 g_2 + p_3 p_2 g_1 + p_3 p_2 p_1 g_0, \quad P_1 = p_3 p_2 p_1 p_0 .$$

$$G_2 = g_7 + p_7 g_6 + p_7 p_6 g_5 + p_7 p_6 p_5 g_4, \quad P_2 = p_7 p_6 p_5 p_4$$

Actually, we could immediately write the formulas for c_{11} and bits c_{12} $-c_{15}$, but because in manufacture it is necessary to allow for limitations of packaging (including pins and power consumption), we started by designing only a 12-bit carry generator. This c_{11} is not led out, but instead terminals for the overall carry propagation P_j and the overall carry generator G_j were added for the purpose of expanding the carry chain (to 24, 36 or more places). When expanding to a 36-bit carry generator, the maximum delay is only 6 levels.

The formula for terminals P_j and G_j on a single chip is

$$P_J = P_3 P_2 P_1$$

$$G_J = G_3 + P_3 G_2 + P_3 P_2 G_1$$

where

$$G_3 = g_{11} + p_{11} g_{10} + p_{11} p_{10} g_9 + p_{11} p_{10} p_9 g_8$$

$$P_3 = p_{11} p_{10} p_9 p_8$$

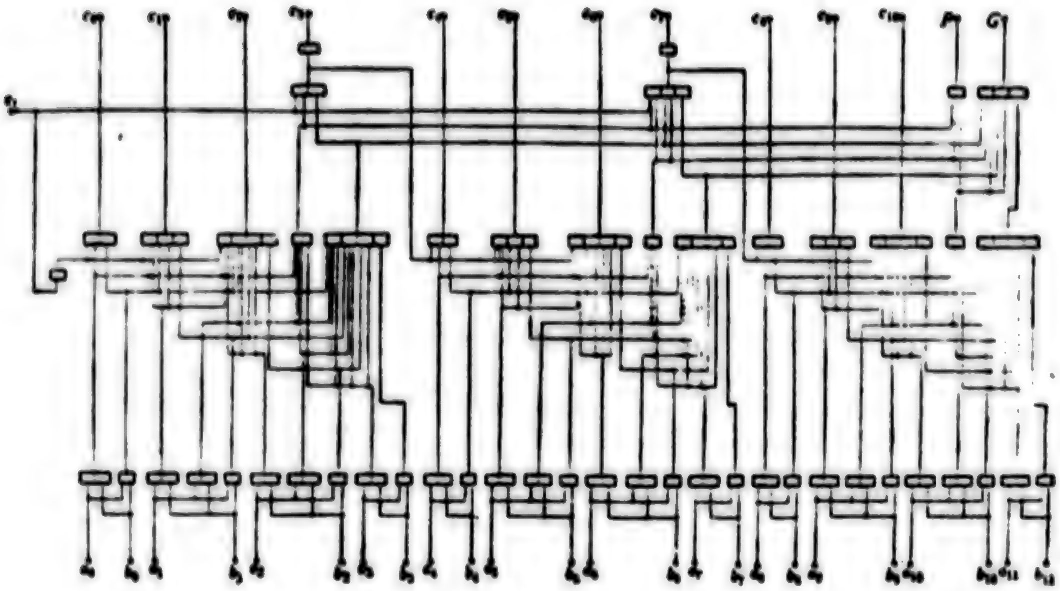


Figure 3. Multielement Logic 12-Bit Carry Generator

If we use an AND-NOR gate to implement the logic of the DYL 12-bit high-speed carry generator, we can see from just the number of circuits and from a comparison of the number of levels of delay between data input and carry output (Table 1) that this approach has clear advantages.

Table 1. Comparison of DYL 12-HSCG Circuit and AND-NOR Circuit

	DYL 12-HSCG	AND-NOR
Number of gates	102	130
Number of levels on chip	4	8
Number of levels after expansion	6	12

Clearly it would be difficult to implement this kind of logic with ECL or TTL, which requires that we make major changes in terms of logic design. Nonetheless, as regards number of components, power consumption, speed and ease of manufacture, multielement logic circuits have their own points of originality.

3. Applications of the DYL 12-Bit High-Speed Carry Generator

The carry generator's applications can be divided into two types: one is as a carry generator for a full adder or parallel counter, and the other is as a data comparator, i.e. a random function performance tester.

In describing its uses, we first discuss the expansion of the carry chain, a logical diagram of which is shown in Figure 4.

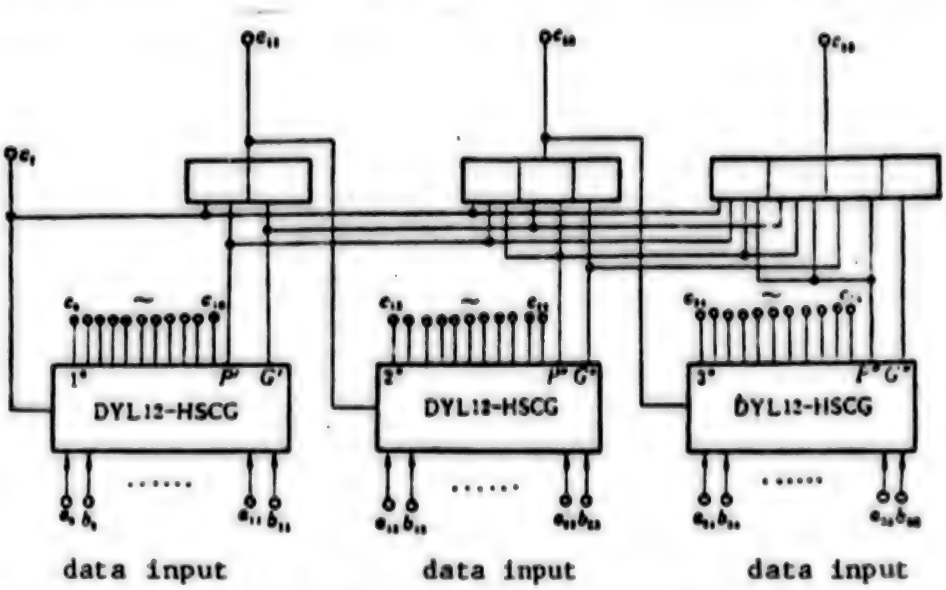


Figure 4. Logic Diagram of Expanded Carry Generator

If we let P', G', G", G", P''',G''' be the input terminals of the DYL 12-bit high-speed carry generator, when the carry chain is expanded to 36 bits, the logic equations are

$$c_{11} = G' + P' c_I$$
$$c_{23} = G'' + P''G' + P''P' c_I$$
$$c_{35} = G''' + P'''G'' + P'''P''G' + P'''P''P' c_I$$

A. Design of a Full Adder

From the formula

$$\Sigma_n = \bar{c}_n(a_n + b_n + c_{n-1}) + a_n b_n c_{n-1}$$

it is clear that the DYL 12-HSCG has only to be provided with some SSI inverters and AND and OR gates to produce a full adder (Figure 5). The threshold element is included for signal recovery.

B. Design of a Parallel Counter

We have the formula

$$cp_n = cpQ_0Q_1Q_2\cdots Q_{n-1}$$

where cp_n is the counter output signal of the n-th bit in the parallel counter and Q is the counter output.

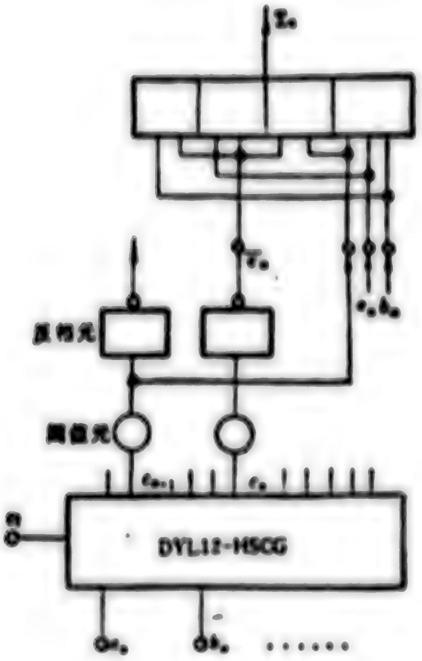


Figure 5. Carry Generator Used as Full Adder

Key: (1) Inverter (2) Threshold device

In the carry generator logic, if we set all b_i equal to zero, we have

$$c_n = c_i a_0 a_1 a_2 \ldots a_n.$$

These two formulas have the same form. Accordingly, if we connect cp to c_i and Q_n to a_n, and all b_i are zero, then the carry output c_n will be the counter input of the (n + 1)-th counter. An n-bit look-ahead carry generator can be wired to form an n+1 bit parallel counter; one type of connection is shown in Figure 6.

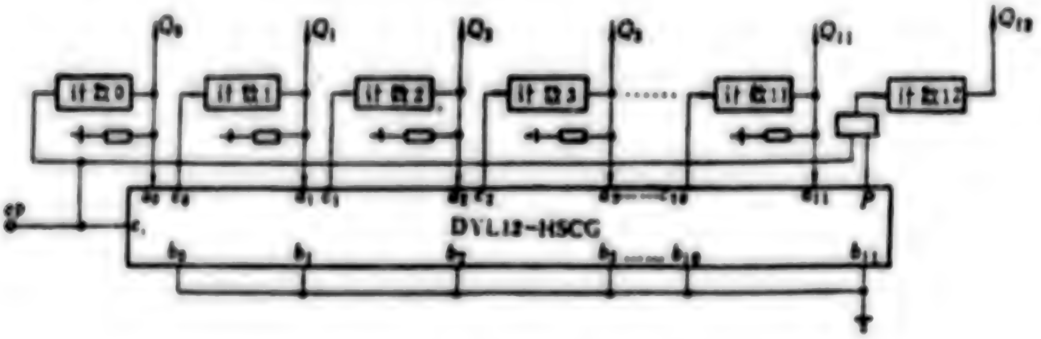


Figure 6. Carry Generator Used as Counter

C. Designing a Comparator

In order to save space, we will summarize the logic conditions for using the DYL 12-HSCG as a comparator. We specify that on receiving a test pulse, if the signal being tested and the standard signal have the same logical signal level, the comparator output is 0; otherwise it is 1. We feed the standard signal to a_0, a_1, ..., a_n and the signal being tested, via an inverter, to b_0, b_1, ..., according to the formula

$$c_n = G_n + P_n G_{n-1} + P_n P_{n-1} G_{n-2} + \cdots + P_n P_{n-1} \cdots P_0 c_i = G + P c_i$$

When $c_i = 0$, then $c_n = G$. Under normal circumstances, $a_i \neq b_i$, $c_n = 0$, and this is used as the comparator output, which is in complete agreement with the stipulation above. And provided that there is one $a_i = b_i$, i.e. the i-th tested signal agrees with the standard signal, then under random test conditions we will inevitably get $c_n = 1$. This error signal can be stored and indicate a failure. Accordingly, we can obtain the following formula

$$Q_1 = \bar{c}_i c_n$$

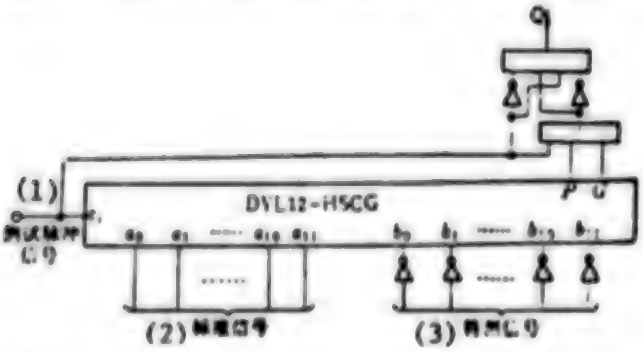
where Q_1 is the comparator output when $c_i = 0$. When $c_i = 1$, $c_n = \overline{G + P}$, and $P = \prod_{i=0}^{n} (a_i + b_i)$. The correct signal has a_i and b_i complementary, so that $P = 1$, $c_n = 1$, and in order to meet the condition that the comparator output Q is zero, in this case we must choose $\bar{c}_n = \overline{G + P}$. Similarly, we can correctly determine whether or not the signal being tested is normal. Accordingly, we can also obtain the following formula:

$$Q_2 = c_i \bar{c}_n,$$

where Q_2 is the comparator output when $c_i = 1$. Accordingly, the comparator output Q can be expressed as

$$Q = Q_1 + Q_2 = \bar{c}_i c_n + c_i \bar{c}_n = c_i + c_n.$$

Figure 7 shows the wiring of the 12-bit comparator.



Key:
(1) test pulse
(2) standard signal
(3) signal to be tested

Figure 7. Carry Generator Used as a Comparator

Manufacturing Design

The basic unit of the DYL 12-bit high-speed carry generator is the DYL linear AND-OR gate,of which there are a total of 102, with 15 being added to meet the load condition (fanout of 4), with a total of 282 emitters and 202 resistors.

A. The Basic "Linear AND-OR Gate" Unit

We first specify the requirements for large (β_1) and small (β_2) gain. When two emitter structures are both located on the positive side, the logic difference can fall to a minimum, and the speed will be a maximum. On the basis of the equivalent circuits in Figure 8 (single input, full load condition), we can write the following two inequalities

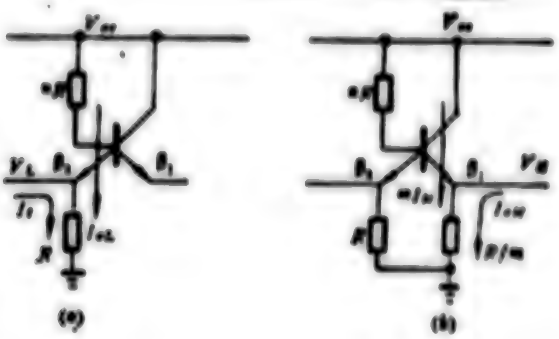


Figure 8. Equivalent Circuits of Linear AND-OR Gates

$$\frac{V_{ee}-V_D}{1+(n/(1+\beta_2))}<V_L \qquad \frac{V_{ee}-V_D}{1+(mn/(1+\beta_1))}>V_H$$

i.e.

$$\beta_2<\frac{nV_L}{V_{ee}-V_D-V_L}-1, \qquad \beta_1>\frac{mnV_H}{V_{ee}-V_D-V_H}-1$$

where β_2 is the large-current gain and β_2 is the small-current gain, V_{ee} is the source voltage, V_D is the voltage drop, V_L is the output low value, V_H is the output high value, m is the fanout and n is the resistance ratio in the circuit. If we substitute the following specific figures: m = 4, n = 2.3, V_{ee} = 5V, V_D = 0.8 V, V_H = 3.4V, V_L - 1.5 V, we obtain: $\beta_2 < 0.27$, $\beta_1 > 38$.

To allow for power supply variations, we take $\beta_2 < 0.2$, $\beta_1 > 100$.

The basic structure of the linear AND-OR gate base logic circuit developed on the basis has already been reported in DIANZI XUEBAO No 2, 1978.

B. High-Resistance Process

To allow for the power-handling limitations and manufacturing parameter variations of the package, we took 300 mW as a middle power consumption value. Accordingly, for an individual circuit nR = 15 kilohms. On the basis of a comprehensive analysis of manufacturing deviations, the amount of current which a unit resistance strip of width W will allow to pass and the temperature coefficient, we chose the electrical strip width W as 20 microns, R_s = 3 kilohms per square, and used the ion implantation process to produce the high resistances.

The industrial procedure which we chose is as follows: after diffusion of the high-concentration area (for the low β_2 base region) and predeposition of the low-concentration area (for the high β_1 base region), we cut the resistor windows and carried out ion implantation of boron, after which it was rediffused to assure that the implantation layer would have a certain depth.

Because there was no specific requirement regarding the implantation depth δ, it was possible to use a 10^5V low-energy implantation device to carry out the process.

The implantation dose formula is

$$Q'_s = \frac{1}{q\bar{\mu}_p R_s}$$

where $q = 1.6 \cdot 10^{-19}$C, $\bar{\mu}_p = 150$ cm^2/V·sec, R_s = 3 kilohms per square. Accordingly, $Q'_s = 1.4 \cdot 10^{13}$ cm^{-2}. If $\delta = 0.4$ microns, during the diffusion process the dopant will be redistributed, all of the dopant within the implantation depth will be fixed by the oxide layer, and about half of the dopant will make no contribution to conductivity. Because redistribution is a rather complex process, we generally take $Q_s = 2Q'_s = 2.8 \cdot 10^{13}$ cm^{-2} as a reference value for the quantity of implanted substance.

C. Layout

The DYL 12-bit high-speed carry generator requires no interconnection steps (no isolation necessary) and accordingly is made on a single chip, using one buxian [1580 4848]. The minimum emitter area is 5 microns, the finest aluminum strip 12.5 microns, the minimum spacing is 10 microns, and there is a total of 40 external contacts. The chip including the contacts is about 2.4 x 2.4 mm square, and it is packaged in an Yixing-produced ST-40Z package.

5. Experimental Results

We tested two lots of wafers, not under high cleanliness conditions; the maximum yield per wafer was 10.7 percent.

Typical process parameters were as follows: the starting material was an n-type dislocation-free monocrystal with a resistivity of 0.3 ohm-cm; the high-boron base area resistance R_{B2} was 8 to 10 kilohms per square; the depth x_{jc2} was 2.5 microns; $\beta_2 = 0.1 - 0.3$; the low-boron base area resistance R_{B1} was 200-300 kilohms per square; the depth x_{jc1} was 1.3 microns; $\beta_2 = 100 - 300$; the ion implantation resistance R_B was 2 to 4 kilohms per square; and power consumption when $V_{ee} = 5V$ was about 200 - 400 mW.

We carried out complete capability testing using a random function generator, which indicated that it operated normally and was reliable and stable. In AC tests, the DYL 12-HSCG's delay time per level was found to be about 2 ns. A diagram of the delay testing principle and waveform charts are given in Figure 9.

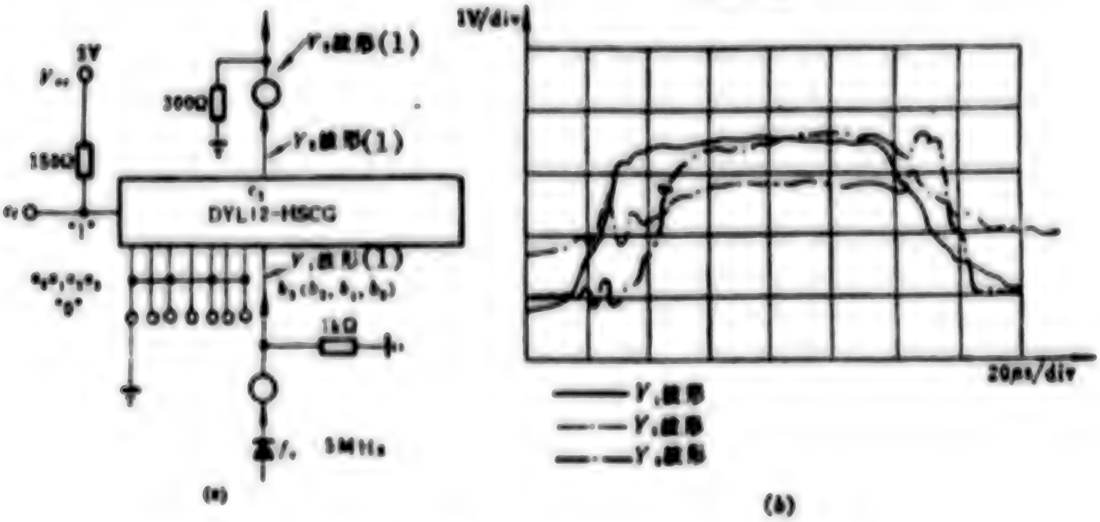


Figure 9. Delay Test

Key:
(1) Waveform
(a) Determination of maximum delay
(b) Delay test waveforms

Conclusions:

The DYL 12-bit high-speed carry generator is a typical high-speed LSI multicomponent logic circuit. Implementation of this new structure with "linear AND-OR gates" has many switches, shifters and programmable logic arrays (PLA).

Experience indicates that the DYL is a highly viable type of high-speed logic circuit.

This work was carried out jointly with the DYL-1300 microprocessor development group, and was energetically assisted by relevant comrades.

Table 2. Typical Parameters of DYL 12-Bit Carry Generator

Number of bits	12
Maximum current (full number of bits)	80 mA
Power supply	5V
Maximum delay time	Under 20 ns (including threshold device; intrinsic delay time 8 ns)
Number of units needed for expansion to 48 bits	4 chips and small gate circuit
Maximum delay time when expanded to 48 bits	Slightly over 20 ns
Current when expanded to 48 bits	320 mA

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APPLIED SCIENCES

SIMPLIFIED CALCULATIONS OF TWO-WAY SLABS, CYLINDRICAL SHELLS

Nanjing GONGXUEYUAN XUEBAO [NANJING ENGINEERING ACADEMY JOURNAL] in Chinese No 4 Dec 79 pp 11-24

[Article by Ding Dajun [0002 1129 6874]: "Simplified Calculations of Two-Way Slabs and Cylindrical Shells." This article was received in January, 1979]

[Text] Abstract

In this article, the writer criticizes the simplified method of calculating two-way slabs as proposed by H. Marcus and used for many years in some nations. Based on the basic concepts of the theory of elasticity, a new computational method is proposed. The concepts of mechanics of the new method is clear. It can also be used to calculate other two-way slabs under conditions in which the previous method is ineffective.

In calculating the cylindrical shells, the writer criticizes the simplified method of computation proposed by Vlasov and suggests a simpler method from the theory of mechanics of materials to compute this more complex spatial problem in the theory of elasticity. In addition, the relationship of finite difference between torsional moments and transverse moments is used to solve the computational problem of intermediate length shells which had not been solved by ordinary simplified methods.

From 1968 to 1970, we proposed the use of "media in the theory of lever mechanics to calculate two-way slabs," "media in the theory of lever mechanics to calculate housings of cylindrical shells," and "media in the theory of lever mechanics to calculate tubes."[1] The methods of lever mechanics were used to calculate two-way slabs and cylindrical shells. Relatively rare and more complex problems in the mechanics of elasticity were reduced to frequently encountered and more familiar computational problems of structural mechanics of lever systems, thus avoiding the use of more difficult and profound mathematical theory so that ordinary technical personnel can more conveniently grasp the design and calculation of these spatial problems. Although today our nation's computer technology has gradually become popular, yet simplified calculations still have a definite significance in the present stage. At the same time, clear concepts of mechanics are also very necessary.

I. Two-Way Slabs

1. Two-Way Slab Supported on Four Sides

In our nation in the past, the method of H. Marcus [2] * was customarily used for calculations of two-way slabs supported on four sides and bearing an evenly distributed load according to the theory of elasticity. This method involves cutting a strip of unit width in the x and y directions at the center of the slab (Figure 1a). The loads q_x and $q_y = q - q_x$ (Figure 1b) in the two directions are calculated on the basis that the deflections of the center span are equal. After calculating the bending moments M_x^0 and M_y^0, they are separately multiplied by the empirical coefficients ν_x, ν_y that take into consideration the effects of torsional moments for correction (reduction). The results are the computed bending moments M_x and M_y needed. Even though the use of emperical coefficient for correction can yield a sufficiently accurate computed bending moment, the load distribution is not consistent with actual situations. At the same time, via what mechanism does the torsional moment reduce the bending moment of the center span, the physical concepts involved are not clearly understood and cannot be directly perceived. For the deflection of the center span of the strip Y_1Y_1 next to the support shown in Figure 1a and the deflection next to the support of the strip of the center span cut out in the x direction to be equal, the load at the point of intersection of the two strips should mostly be transmitted to the strip in the x direction. The load on the support should be borne entirely by the strip in the x direction. Thus distribution of the vertical load will be as shown by the curve illustrated in Figure 1c, not an even distribution as illustrated in Figure 1b. In practical use, the curve is taken as a sine curve or a parabola. In addition, the effects of torsional moment can be directly taken into consideration by the following method.

Let the Poisson ratio $\mu = 0$, then the increment of the torsional moment on a unit length in the y direction is:

$$\frac{\partial}{\partial y}M_{xy}\cdot 1 = \frac{\partial}{\partial y}\left(-D\frac{\partial^2 w}{\partial x \partial y}\right) = -D\frac{\partial}{\partial x}\cdot\frac{\partial^2 w}{\partial y^2}$$

Thus the bending moment at n on any section of the strip in the x direction caused by this increment of torsional moment is:

$$\int_0^{x_n}\left(-D\frac{\partial}{\partial x}\cdot\frac{\partial^2 w}{\partial y^2}\right)dx = -D\frac{\partial^2 w}{\partial y^2}\Big]_0^{x_n} = M_{yn} \tag{1}$$

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*In recent years, foreign journals still recommend the approximation method of calculation[11,12]; Reference[13] is a written work on the theory of plates, in which this method was still introduced in detail in the section on "the engineering method of designing continuous rectangular building boards."

The reduction of the bending moment at n on the section in the x direction caused by torsional moment is equal to the bending moment at n on the section in the y direction.

The load distribution diagram shown in Figure 1c points out the true nature of the problem. The two-way slab supports an even load via the mechanism of two-way strips of unit width, one supporting the curved load on the top and the other on the side supporting the distributed torsional moment.

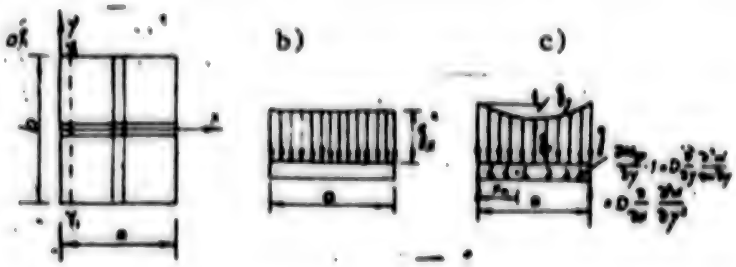


Figure 1.

It can thus be seen, in addition to the deflections w (calculated by taking into consideration the effects of torsional moment) at any point n on the two-way strip that are equal, there is also a static condition.

When calculating along the x direction:

$$M_{xn} = M^{o}_{xn} - M_{yn} = \Phi(q, a, \frac{a}{b}) - M_{yn} \qquad (2)$$

where M^{o}_{xn} does not take into consideration the value of the bending moment under the influence of the torsional moment.

Thus we have: $M_{xn} + M_{yn} = M^{o}_{xn}$ (3)

Similarly, when calculating along the y direction, then:

$$M_{yn} + M_{xn} = M^{o}_{yn} \qquad (4)$$

Let equation (3) equal equation (4), we then obtain the distribution of vertical load in the two directions. This is also the static condition mentioned above.

Based on the condition of equal deflections of the center span, we can obtain the computed bending moment of the center span in the two directions.

When $\mu \neq 0$, we know from the fundamental formulas for the thin elastic slab:

$$\left.\begin{aligned} M_x &= M_{ox} + \mu M_{oy} \\ M_y &= M_{oy} + \mu M_{ox} \end{aligned}\right\}$$

where M_{ox}, M_{oy} are the calculated bending moments of the center span in the two directions when $\mu = 0$.

Example 1. Compute the simple square supporting plate that bears an even load. Obviously we have here:

$$q_x = q_y = 0.5\,q$$

When we assume q_y on the strip in the x direction is taken to be a sine curve, then

$$M_x + M_y = \frac{qa^2}{8} - \frac{0.5qa^1}{\pi^2} = 0.125qa^2 - 0.0507qa^2 = 0.0744qa^2.$$

Let $M_x = M_y$, then $M_x = M_y = 0.0372qa^2$.

When we assume q_y is a parabola, then: $M_x = M_y = 0.03645\ qa^2$. The accurate solution: $M_x = M_y = 0.0368qa^2$. Solving by the method of reference (2), $M_x = M_y = 0.0364qa^2$. Thus it can be seen that the method described in this article is sufficiently accurate.

Example 2. Calculate the $b = 2a$ simple rectangular support plate with an evenly distributed load q.

$$M_A^o = \frac{qa^2}{24}(1 + 5k_1 + 3k_2);$$
$$M_B^o = \frac{qa^2}{24}(1 + 6k_1 + 5k_2)$$

If we assume that along the short span the bending moment is a parabola, then we have

$$\frac{qa^2}{24}\ (1 + 5k_1 + 3k_2) = \frac{qa^2}{8}\ \left(1 - \frac{5}{6}\,k_1\right)$$

Similarly for point B,

$$\frac{qa^2}{24}\ (1 + 6k_1 + 5k_2) = \frac{qa^2}{8}\ \left(1 - \frac{5}{6}\,k_2\right)$$

The two groups of equations above can be solved: $k_1 = 0.235$, $k_2 = 0.0782$. Substituting k_1, k_2 into the equations M_A^o and M_B^o, we obtain $M_A^o = 0.1005qa^2$, $M_B^o = 0.1168qa^2$. When we approximate the diagram of the bending moment by a straight line to determine w_{yA} and w_{yB}, and at this time we assume that along the lengthwise span the bending moment caused by the torsional moment also becomes a broken line (Figure 3), then:

$$EIw_{yA} = 0.03543qa^4 - \frac{5M_{xA}}{24}a^2 - \frac{5M_{xB}}{8}a^2.$$

$$EIw_{yB} = 0.04934qa^4 - \frac{M_{xA}a^2}{4} - \frac{5}{24}M_{xB}a^2$$

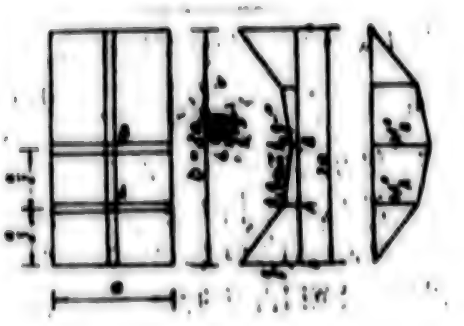


Figure 2.

Figure 3.

Let us assume that the curve of the load along the x direction and the bending moment caused by the torsional moment are both parabolically distributed, then:

$$EIw_{xA}=0.01094qa^4-0.1042M_{yA}a^2,$$

$$EIw_{xB}=0.01232qa^4-0.1042M_{yB}a^2.$$

Let $w_{xA}=w_{yA},\ w_{xB}=w_{yB},$, and we add two more static conditions:

$$M_{xA}+M_{yA}=0.1005qa^2,$$

$$M_{xB}+M_{yB}=0.1168qc^2$$

Solving them simultaneously we obtain: $M_{xB} = 0.0995qa^2$ (the accurate solution is $0.0938qa^2$), $M_{xA} = 0.072\ qa^2$, $M_{yA} = 0.0285qa^2$(the accurate solution is $0.0232qa^2$), $M_{yB} = 0.0214qa^2 < M_{yA}$, i.e., the greatest bending moment along the lengthwise direction is not at the center of span.[2,3]

If we assume the load and the bending moment are distributed as a sine curve, then $M_z = 0.0943qa^2$, $M_y = 0.0236qa^2$. But at this time, we assume that they occur at the center of span of the lengthwise span.

Example 3. Calculate the simple square supporting plate of partial load (Figure 4).

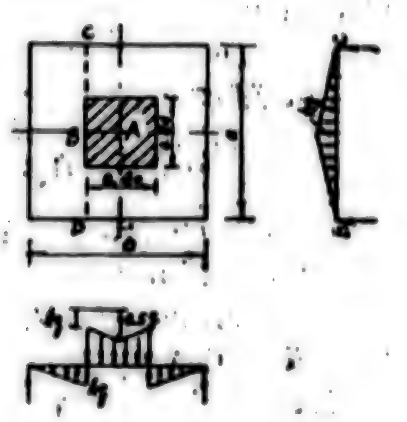


Figure 4.

For point B

$$M_{xB}+M_{yB}=\frac{kq}{2}\,\frac{a}{2}\,\frac{2}{3}0.5a=\frac{(q-kq)+0.5q}{2}\times 0.2a\times 0.3a$$

$$-\frac{1}{2}kq\times 0.3a\times 0.2a$$

$$kq=0.314q.$$

For Point A $\quad M_x+M_y=2M_x=2M_y=0.03741qa^2$

then: $$M_x=M_y=\frac{0.03741}{2}\cdot\frac{P}{0.16a^2}a^2=0.1168P.$$

The accurate answer is 0.108P,[4] an error of + 8 percent.

Example 4. Calculate the square plate of evenly distributed load affixed on four sides.

For the plate that is fixed on two sides, consideration is given to the characteristics of the deflection curve, i.e., at this time, the deflection in that part of the plate near the support is very small. Therefore within this part the load transmitted to the vertical sides is greater. The load distribution curve is assumed to be as shown in Figure 5(a). For the calculations below, we should divide it into an upward (middle part) and a downward (near the support) part and calculate it as a sine curve. At this time, the bending moment at the center of the span is:

$$M_o = -\frac{q_o a^2}{8\pi^2};$$

and the bending moment at the support is:

$$M_k = -\frac{q_o a^2}{8\pi^2} \qquad (5)$$

The bending moments of the center of span and at the support are respectively:

$$M_o = (1-\frac{2}{\pi})\,M_y = 0.365M_y, \quad M'_k = \frac{2}{\pi}\,M_y = 0.635M_y \qquad (6)$$

When the plate is square, the load distribution is as shown in Figure 5(b), at the center of span, $M_z = M_y$, thus we obtain:

$$M_z + 0.365M_y = 1.365M_z = qa^2\left(\frac{0.75}{24} - \frac{0.5}{8\pi^2}\right) = 0.02487qa^2.$$

$M_z = 0.01822qa^2$ (the correct solution is $0.01803qa^2$) and

$$M_k = -qa^2\left(\frac{0.75}{12} - \frac{0.5}{8\pi^2}\right) + 0.635\times0.01822qa^2 = -0.04462qa^2$$

(the accurate solution is $-0.04737qa^2$).

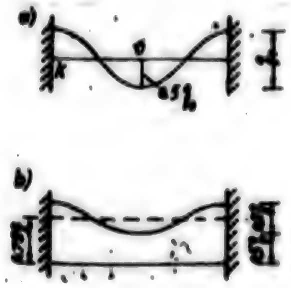


Figure 5.

According to the method of calculation in Reference (2), at this time,

$$M_k = \frac{0.5qa^2}{12} = 0.04178qa^2$$

The Reference (2) also corrected the result by dividing it by the torsional moment correction coefficient:

$\nu_1 = \nu_2 = 0.861$, thus: $M_k = 0.0484qa^2$. Now, all the common methods do not divide it by ν, thus the error is slightly larger.

2. The Plate on the Elastic Support

Because the support is elastic, the bending moment in the lengthwise direction along the support of the strip on the support will not be zero anymore. This should be taken into consideration when calculating the bending moment caused by the torsional moment.

Example 5. Calculate the square plate[4] bearing an evenly distributed load and supported by simple supports on four sides on beams with the same elastic shift (Figure 6).

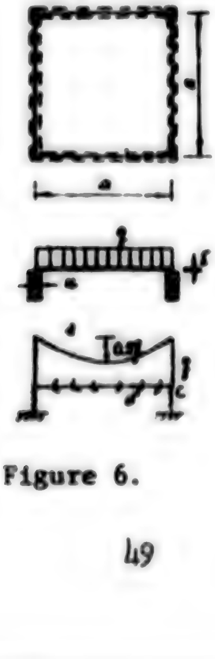


Figure 6.

Assume $\mu \neq 0$, then the bending moment caused by the torsional moment in the strip is:

$$\int_c^d D(1-\mu)\frac{\partial^3 w}{\partial x \partial y^2}\,dx = (1-\mu)\left[D\frac{\partial^2 w}{\partial y^2}\right]_c^d = (1-\mu)(M_{oyd}-M_{oyc}) \tag{7}$$

where M_{oyc} is the bending moment of the strip on the beam along the lengthwise direction of the beam when $\mu = 0$. Because the bending moment in the other direction (perpendicular to the beam) is 0, $M_{oyc} = M_{yc}$, and in the following calculations we let it be ΔM.

Assume $E_a I_a$ is the rigidity of the beam on the u axis.

$D = \frac{E\delta^3}{12(1-\mu^2)}$ is the rigidity of the cylindrical pillar of the plate.

If the greatest bending moment being borne by the beam is M_1, then:

$$\Delta M = M_1 \frac{D}{E_a I_a} \tag{8}$$

At this time, the static conditions are:

$$M_x = 0.125qa^2 - \frac{0.5qa^2}{\pi^2} - (1-\mu)(M_{oy} - \Delta M)$$

Since $M_{oy} = \frac{M_y - \mu M_x}{1-\mu^2}$, $M_x = M_y$, we can substitute it into the above and obtain:

$$M_x + \frac{M_y - \mu M_x}{1+\mu} - 0.0744qa^2 = (1-\mu)\Delta M$$
$$\Delta M = \frac{2M_x}{1-\mu^2} - \frac{0.0744qa^2}{1-\mu} \tag{a}$$

The balancing condition of the total bending moment at the time the entire plate is cut open along the center of span is:

$$\frac{2(M_x - \Delta M)a}{\pi} + \Delta M a + 2M_l = \frac{1}{8}qa^2.$$

Substituting equation (8) into it, we have:

$$\frac{2(M_x - \Delta M)}{\pi} + \Delta M + 2\frac{E_a I_a}{Da}\Delta M = \frac{1}{8}qa^2$$

Then we substitute equation (n) into it and let $\mu = 0.25$. Finally we obtain:

$$M_x = \frac{0.1609 + 0.198\gamma}{1.411 + 4.27\gamma} qa^2$$

$$\text{Here,} \quad \gamma = \frac{E_0 I_0}{Da} = \frac{12 E_0 I_0 (1-\mu^2)}{E\delta^3 a}.$$

The values of M_z and ΔM obtained for different γ are very close to the values listed in Table 340 in Reference (4).[1]

Suspended Plate

A torsional moment M_{xy} due to deformation is produced at the end of the suspension arm. The torsional moment is reduced to a single force acting on dy (Figure 7a) and is combined as a continuously distributed force $q'l_y$. When divided into strips for calculation, a force in the reverse direction should be added at the end of the suspension arm to cancel the torsional moment of the end of the suspension arm.

The concentrated force is only exerted on the end of the suspension arm of the strip calculated along the x direction while the force in the strip on the side of the y direction is not counted. This is done to cancel the torsional moment at this place to satisfy the boundary condition $M_{xy} = 0$. The condition $Q_x = 0$ on the side has already been automatically satisfied by the suspension arm strip.

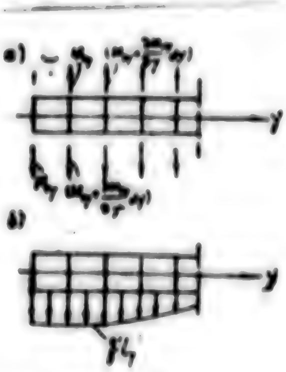


Figure 7.

Because an unknown q' has been added, therefore besides the static condition at the intersection of the two way strip and the condition of continuity of deformation, balancing conditions of the bending moment should also be added, i.e., the conditions of total balance of the half of the slab cut along the free vertical side should also be utilized. An actual example of calculations is unnecessary.[1]

In addition, the method proposed in this article can also be used to compute the continuous slab, variable thickness slab, triangular slab, large deflection slabs and stability of slabs.[1] It can also be used for calculating anisotropic slabs; the method of lever mechanics can also be used to calculate circular slabs and ring shaped slabs[1] which we will not repeat here.

II. Cylindrical Shell

Massive calculations of the housing of cylindrical shells show that the distribution shell is as shown in Figure 8, i.e., the stress diagram of the curve of the pulling force within the scope of the inside of the top and the curve of the pressure at the center is superimposed on the straight line distribution diagram.

An ordinary explanation is that stress is the effect of transverse bending. But this is very generalized and ambiguous. By what mechanism (structural action) does transverse bending affect longitudinal stress? Generally, related writings have not provided a clear and definite answer to this question.

Now let us study the typical graph of positional change under a load. According to the basic formula of the cylindrical shell, when the positional change w in the normal direction of the known shell body and the longitudinal bending moment M_z have the following relationship ($\mu = 0$):[6]

$$w = \frac{M_x}{EIk^2}, \quad k = \frac{\pi}{l}$$

Then we can obtain the positional change diagram from Table 7 of Reference (6) as shown in Figure 9. It can be seen from the diagram that after transverse bending and deformation causes a positional shift of the cylindrical shell, the positional shift diagram of the beam under stress distributed in a straight line will show a bulge at the center and the two sides bend downward, i.e., at this time the body of the shell becomes steeper. In general, it is frequently believed that the cylindrical shell becomes flatter after a positional shift. This is an illusion due to people's habit of clasping their hands inward simultaneously to show how a structural object receives positive bending moment of force, because this is actually equivalent to applying positive bending moments on the two ends of the cylindrical shell. But we are discussing deformation under the positive bending moment (whole body) caused by downward distributed loads along the surface of the shell. Further study of Figure 9 shows relative to the positional change curve of the beam, the tangent shift v of the point a on the side of the shell is downward, while the point b near the top of the shell moves upward (at the top of the shell v=0, the symmetric load).

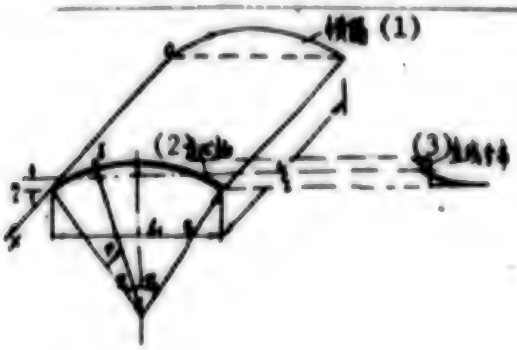


Figure 8.

Key:
(1) Diaphragm
(2) Center of gravity axis
(3) Straight line distribution

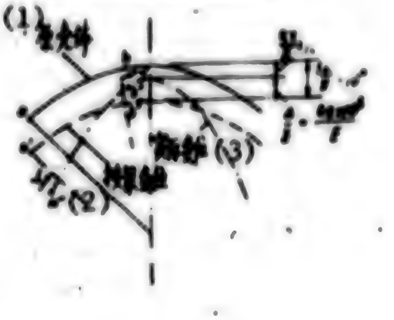


Figure 9.

Key:
(1) Original shell body
(2) Positional shift about the beam
(3) Actual positional shift

The load of the known shell is transmitted to the support (transverse diaphragm plate) mainly via the shearing force S. If the cylindrical shell is regarded as made up of many strips (arc plates) (as a folded shell), then the average tangent shift of the strips on the side and nearby parts is downward in relation to the positional shift of the beam while at the top of the shell and nearby parts the shift is upward (notice here we are talking about the average tangent shift of the strip of a definite width, not the tangent shift of a certain point of the body of the shell, therefore as described above, $v = 0$ at the tip of the shell).

Therefore, relative to the straight line distribution of the longitudinal stress (beam stress), this added tangent shift (folded plate's deflection) caused by the transverse bending will produce added stress. If a half shell is roughly divided into two broken plates, the broken plate below bends and deflects downward within its surface, thus the bottom part (near the edge of the shell) is pulled, and the top part (the center of the shell) is pressured. The broken plate on top bends and deflects upward and thus the top (near the tip of the shell) is pulled, and the bottom (center of the shell) is pressured. Also, because the longitudinal (whole body) bending moment caused by the load upon the body of the shell body has already been satisfied by the beam stress, the point of combined action of the added pull and pressure should coincide (i.e., the sum of the moments at any point is 0). This also requires that the added stress diagram has a distribution as described above.

Now we can say in general that because the spatial position after each point undergoes a positional shift on the transverse section of the body of the shell due to transverse bending is not the same as the position determined by the beam theory, thus added pulling stress is produced at the tip of the shell and the bottom part and added pressure stress is produced within the central part of the height. This is the effect of transverse bending upon longitudinal stress in the housing of the cylindrical shell (relative to the beam stress).

The thinner the shell, the greater the added tangent positional change, therefore the corresponding added stress is greater. The smaller the span l of the shell, the added stress will be greater when there is a similar added tangent positional shift. When other conditions are the same, the larger R is, the longer the arc. Thus the resulting tangent positional change of transverse bending is greater, the added stress is greater. The converse is true. Therefore when $\frac{R}{l}$ is very small, the added stress is unimportant (besides a small numerical value of the beam itself at this time is also very large, and thus it can be neglected), i.e., the cylindrical shell at this time can be calculated according to the beam. It should be noticed that the larger angle of tension of the shell φ_k, the greater the transverse bending. Thus the added stress is greater, and the greatest boundary value $\frac{R}{l}$ (or $\frac{l'}{l}$) calculated according to the beam is not a constant, but becomes small as φ_k increases. Generally, it is taken as a constant in related writings (such as calculating according to the beam when $\frac{R}{l} \leqslant 0.2$)[8] and this is incorrect.

As mentioned above, under a load, transverse bending of the cylindrical shell exerts such an important effect upon the distribution of longitudinal force but it is not isolated. It is not only related to the load, it is also bounded by the inner longitudinal force (shearing force S, thus the stress in the normal direction is σ). This reveals the inner mutual relationship between the nature of the cylindrical shell and the inner force.

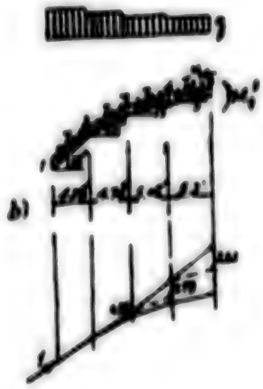
Because subjecting the cylindrical shell to force is a spatial problem, its calculations are naturally more complex than the planar lever system. Generally the problem is solved by the method of solving differential equations. The computational work involved is extremely burdensome. There are two ways to simplify the calculations. One way is to compile a table of coefficients according to the theory of elasticity as in Reference (7), or reduce the spatial problem to a lever system and use algebraic equations to obtain an approximate solution.[9] The former calculations are relatively easy when the conditions fit the situation described in the table. The latter frequently requires computations involving many lengthy formulas that are not easily remembered to obtain the coefficients of the equations and at the same time it is limited to calculating longer shell bodies. In addition, the two methods do not provide a very clear physical concept of the mutual effects and limitations of the longitudinal and transverse inner forces.

This article will suggest a new method of calculation based on the second way and on the characteristics of the forces being exerted. The formulas used are all the most basic ones therefore the method is very easily grasped. At the same time, the concepts of spatial forces exerted are clear and it can be used to calculate long cylindrical shells.

1. Calculation of a Housed Long Cylindrical Shell

In calculating a long cylindrical shell and in calculating the cylindrical shell more accurately when $\frac{R}{\ell}$ is relatively small (< 0.6), it is generally assumed that the torsional moment can be neglected.[9] This often causes misunderstanding, thus believing that the torsional moment in these cylindrical shells is very small. Actually, the value of the torsional moment at the support of the long shell is not smaller than that at the support of the medium length shell but is, on the contrary, larger (see Table 7 and Table 9 in Reference (6)). But here, because the span is large, the increment of the torsional moment in the arc plate (strip) of unit width cut out along the transverse at the center of the span is relatively small relative to the value of the transverse bending moment. Therefore whether these torsional moments are taken into consideration does not greatly affect $M\varphi$. Thus the final effect upon the distribution of the longitudinal stress is very small. This means, in calculating the tra transverse bending moment and longitudinal stress, the effects of the torsional moment can be overlooked.

We approximate the cylindrical shell (equal sides, this is not just in principle) by a folded shell (Figure 10). At the center of the span (towards the support), we cut out a transverse arc plate of unit width in the shape of a broken line. When the distribution of the shearing stress S on the side of the support is known (along the center of span, S = 0), it is not difficult to calculate the total shearing force T of each plate (by Simpson's rule). Therefore when the effects of torsional moment is not considered, it is not difficult to obtain the Mφ of each node point.



But S is a function of the longitudinal stress σ. If we assume that the distribution of the shear stress along the length of the span is a cosine curve, then the balancing condition of the half span of the strip in the longitudinal direction is:

$$S_{n+1} = S_n + \frac{\sigma n + \sigma n + 1}{2} - A_n k^2 \qquad \text{(a)}$$

where An is the area of the transverse section of the nth strip of the slab.

Thus T is a function of σ, while $\sigma = \sigma^* + \Delta\sigma$, σ^* is the beam stress and a function of the load, thus:

$$T = \Phi_1(q, \Delta\sigma) \qquad (9)$$

and
$$M = \Phi_2\ (q, T) = \Phi_3\ (q, \Delta\sigma) \qquad (10)$$

In transverse calculations, when the diagram of Mφ is already known, the average tangential positional shift of each node point of the folding arc can be obtained by the imaginary work principle, i.e., the area $\bar{A}$ of each piece in the diagram Mφ is multiplied by longitudinal coordinates of the center of gravity of each $\bar{A}$ corresponding to the diagrams of bending moments (transverse) caused by the exertion of unit tangential force at each corresponding point. At this time, the tip of the shell is assumed to be stationary (relative to the positional change of the beam). If the tip of the shell bulges upward by $\frac{\Delta}{E}$, an upward component of tangential shift inside each folded plate will result:

$$v_n' = \frac{\Delta}{E} \sin \alpha_n \qquad \text{(b)}$$

α_n is the inclination angle of the nth folded plate.

Therefore in transverse calculations, the tangential shift will be a function of Δ and Mφ, i.e.,

$$v = \Phi_1(\Delta, M_\varphi) = F_1(q, \Delta, \Delta\sigma) \qquad (11)$$

When considering the longitudinal direction, the (added) longitudinal positional change of the transverse folded arc along the center of span is also the (added vertical) positional change (deflection) of each corresponding longitudinal strip in its own plane at the center of span, thus:

$$\upsilon_n = \frac{(\Delta\sigma_{n+1} - \Delta\sigma_n)\ \beta\ell^2}{b_n E} \tag{c}$$

where β is the deflection coefficient. When σ changes according to the sine law, $\beta = 0.1015$ (when the load is even, it is 0.1041), b_n is the width of the nth folded plate.

Therefore in longitudinal calculations,

$$\upsilon_n = F_2\ (\Delta\sigma) \tag{12}$$

Under symmetric load, when the cylindrical shell is replaced by a folded shell of 2m folds, there will be $m + 1$ $\Delta\sigma$ and one Δ i.e., a total of $m + 2$ unknowns.

Let equations (11) and (12) be equal, then there will be m (linear algebraic) equations. In addition, according to static balance, there will be two equations, therefore it is not difficult to solve simultaneously.

When $\Delta\sigma$ is known, $M\varphi$ can be solved by equation (10).

Using the balanced conditions of the corresponding and separate longitudinal and transverse bodies, shearing force S and transverse force $N\varphi$, can be determined separately.

Example 6. Calculate the long shell in Reference (6) by the method recommended in this article.

We divide the cylindrical shell along the arc into 8 equal parts. The angle of inclination of each folded plate is shown in Figure 10(a). The width of the plate $b = 2 \times 30 \sin 5° = 5.23'$. Calculating the equivalent substitute plates gives $\eta = 4.561'$, $I = 44.17'^4$.

Under a load of $\frac{4}{\pi} \times 50 \sin kx$ (at this time, $M_{max} = 0.1285ql^2$ i.e., 1.028 times the beam stress). We first calculate the shearing stress of the strip of unit width at the center of span (to calculate T by the Simpson's Rule, in addition to the node point, we also calculated the shearing stress at the midpoint between two node points), for example:

$$s_{1-2} = s_1 + \frac{399{,}000 + \Delta\sigma_1 + 259{,}000 + 0.5\Delta\sigma_1 + 0.5\Delta\sigma_2}{2} \times$$

$$\times 0.25 \times \frac{5.23}{2} \left(\frac{\pi}{120}\right)^2$$

$$= (147 + 0.000336\Delta\sigma_1 + 0.000112\Delta\sigma_2)\,{}^{\#}/\square'$$

$$s_2 = s_1 + \frac{399{,}000 + \Delta\sigma_1 + 137{,}000 + \Delta\sigma_2}{2} \times 0.25 \times 5.23 \left(\frac{\pi}{120}\right)^2$$

$$= (239 + 0.000448\Delta\sigma_1 + 0.000448\Delta\sigma_2)\,{}^{\#}/\square'$$

where 399,000.......are the beam stress of each corresponding point.

According to Simpson's Rule, we obtain

$$T_1 = (0 + 4s_{1-2} + s_2)\,\frac{5.23}{2\times 3} = (720 + 0.00156\Delta\sigma_1 + 0.00078\Delta\sigma_2)\,{}^{\#}/'$$

Calculations for the remaining S and T are omitted.

Calculate Mφ (Below, 5.25' is the original arc length, we can also use 5.23'):

$$M_\varphi^1 = -\frac{4}{\pi} \times 50 \times 5.25 \times \frac{4.28}{2} = -712^{\#'}/'$$

$$M_\varphi^2 = -\frac{4}{\pi} \times 50 \times 5.25 \times 9.25 + T_1 \times 0.91$$

$$= -2425 + 0.00142\Delta\sigma_1 + 0.00071\Delta\sigma_2$$

$$M_\varphi^3 = -\frac{4}{\pi} \times 50 \times 5.25 \times 21.88 + T_1 \times 2.7 + T_2 \times 0.91$$

$$= -4042 + 0.00637\Delta\sigma_1 + 0.00568\Delta\sigma_2 + 0.00071\Delta\sigma_3$$

$$M_\varphi^4 = -\frac{4}{\pi} \times 50 \times 5.25 \times 40.08 + T_1 \times 5.32 + T_2 \times 2.7 + T_3 \times 0.91$$

$$= -4{,}602 + 0.01675\Delta\sigma_1 + 0.0189\Delta\sigma_2 + 0.00565\Delta\sigma_3 + 0.00071\Delta\sigma_4.$$

Calculate the average tangential shift in the transverse direction (the upward direction of υ is positive. Refer to Figure 10(b)) showing the graph of bending moment caused by the unit tangential force and notice here the drawing shows the bending moment under pressure. The multiplier after M in the parentheses in the following equation is the longitudinal coordinate of the bending moment at the center of gravity of corresponding parts of the diagram of Mφ. The Mφ diagram is assumed to be of broken lines):

$$v_4 = \frac{\Delta}{E}\sin 5^\circ = 0.08716\frac{\Delta}{E}$$

$$v_3 = \frac{\Delta}{E}\sin 15^\circ + \left(\frac{M_\varphi^5}{2}\times 0.61 + \frac{M_\varphi^4}{2}\times 0.3\right)\frac{5.23}{EI'},$$

Here $I' = \frac{1 \times 0.25^3}{12} = 0.0013'^4$, substituting M_φ above into these equations:

$$v_3 = 0.259\frac{\Delta}{E} - \frac{8.07\times 10^6}{E} + \frac{1}{E}(24.3\Delta\sigma_1 + 26.5\Delta\sigma_2 + 7.34\Delta\sigma_3 + 0.867\Delta\sigma_4)$$

$$v_2 = \frac{\Delta}{E}\sin 25^\circ + \left(\frac{M_\varphi^5}{2}\times 2.1 + \frac{M_\varphi^4}{2}\times 2.12 + \frac{M_\varphi^3}{2}\times 0.3\right)\frac{5.23}{EI'}$$

$$= 0.421\frac{\Delta}{E} - \frac{38.05\times 10^6}{E} + \frac{1}{E}(98.6\Delta\sigma_1 + 104\Delta\sigma_2 + 26.85\Delta\sigma_3 + 2.99\Delta\sigma_4)$$

$$v_1 = \frac{\Delta}{E}\sin 35^\circ + \left(\frac{M_\varphi^5}{2}\times 4.45 + \frac{M_\varphi^4}{2}\times 5.675 + \frac{M_\varphi^3}{2}\times 2.12 + \frac{M_\varphi^2}{2}\times 0.3\right)\frac{5.23}{EI'}$$

$$= 0.573\frac{\Delta}{E} - \frac{98.0\times 10^6}{E} + \frac{1}{E}(228.2\Delta\sigma_1 + 236.2\Delta\sigma_2 + 58.5\Delta\sigma_3 + 6.35\Delta\sigma_4)$$

Calculated according to the longitudinal stress we have:

$$v_4 = \frac{\Delta\sigma_5 - \Delta\sigma_4}{5.23E}\times 0.1015\times 120^3,$$

$$v_3 = \frac{\Delta\sigma_4 - \Delta\sigma_3}{5.23E}\times 0.1015\times 120^3,$$

$$v_2 = \frac{\Delta\sigma_3 - \Delta\sigma_2}{5.23E}\times 0.1015\times 120^3,$$

$$v_1 = \frac{\Delta\sigma_2 - \Delta\sigma_1}{5.23E}\times 0.1015\times 120^3.$$

Let each υ obtained for the two directions be equal, then we have 4 equations.

In addition, based on the static conditions we have:

$$\Delta\sigma_1 + 2\Delta\sigma_2 + 2\Delta\sigma_3 + 2\Delta\sigma_4 + \Delta\sigma_5 = 0$$

$$\Delta\sigma_1 + 5.763\Delta\sigma_2 + 10.271\Delta\sigma_3 + 12.987\Delta\sigma_4 + 6.946\Delta\sigma_5 = 0.$$

By simultaneously solving the 6 equations above (notice: Since υ_4 is equal, Δ can easily be cancelled, thus actually they are simultaneous equations of 5 elements), we obtain the added stress:

$\Delta\sigma_1 = 89{,}300^{\circ}/\square'$, $\Delta\sigma_2 = -48{,}300^{\circ}/\square'$, $\Delta\sigma_3 = -38{,}430^{\circ}/\square'$, $\Delta\sigma_4 = 18{,}350^{\circ}/\square'$, $\Delta\sigma_5 = 46{,}450^{\circ}/\square'$, and the algebraic sum of these and the beam stress (the results of calculation in Reference (6) are listed in the parentheses)

$$\sigma_1 = 488.310^{\circ}/_{\square'}\ (487.768),\quad \sigma_2 = 88,700^{\circ}/_{\square'}\ (111,160)\ ,$$
$$\sigma_3 = -94,100^{\circ}/_{\square'}\ (-80,260),\ \sigma_4 = -154.850^{\circ}/_{\square'}\ (-151.076)\ ,$$
$$\sigma_5 = -167,050^{\circ}/_{\square'}\ (-167,120),$$

Substituting into equation s and multiplying by $\frac{120}{\pi}$, we obtain the shearing force of the support: S_2 = -9,850#/'(-9,727), S_3 = -9,750#/'(-9,746), S_4 = -5,500#/'(-5,553).

Because the longitudinal stress between node points is assumed to be distributed in a straight line, it can be easily obtained: S_{max} = -10,217#/', occurring at φ = 14°52' (measuring from the edge).

Transverse bending moment:

$$M_{\varphi}^{1} = -560^{\#'}/_{'}\ (-400)^{(1)},\ M_{\varphi}^{2} = -2,332^{\#'}/_{'}\ (-1,698),\ M_{\varphi}^{3} = -3,773^{\#'}/_{'}$$
$$(-2,984),\ M_{\varphi}^{4} = -4,224^{\#'}/_{'}\ (-3.504).$$

When considering the effects of the torsional moment upon M_φ, we can obtain results that are even closer to those in Reference (6).

Based on the horizontal components of T_1-- T_4, we can obtain the transverse force N_φ based on the balance of the corresponding separate body of transverse strips. But because broken lines have replaced the curve, where N_φ has two directions at a node point, there is only one direction now, therefore in the calculation, N_φ takes the direction of the original tangent at that node point.

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* If folded plate 1 is further divided into two equal parts and if the distribution of longitudinal stress does not change, then at this time, T in the first folded plate affects M_φ^2; when the divisions increase to infinity, this effect will increase by 30 to 50 percent. Here M_φ is corrected by this method.

** At this time, we can approximate and assume M_φ after correction, then calculate the torsional moment according to equation (e) in section 2, and use the torsional moment thus obtained to correct M_φ, so that the corrected M_φ and the assumption are almost the same and the effect of the torsional moment upon σ is not considered.

*** To facilitate looking up the table of coefficients in References (7) or (8).

[source does not indicate where footnotes ** and *** are to be placed]

In this way we obtain:

$$N_{\varphi}^{4} = -3{,}360 \text{°/·} (-3{,}243), \quad N_{\varphi}^{3} = -3{,}020 \text{°/·} (-2{,}887),$$

$$N_{\varphi}^{2} = -2,\text{[illegible]°/·} (-1{,}898), N_{\varphi}^{1} = -775 \text{°/·} (-642).$$

The calculated results are illustrated in Figure 11. The values in parentheses in the diagram show the original computed results. It can be seen that they coincide sufficiently (except for the larger deviation of Mφ).

To clearly see the effect of υ upon the added stress (directional), we obtain by calculation:

$$\upsilon_4 = \frac{7.85 \times 10^6}{E}, \quad \upsilon_3 = \frac{15.86 \times 10^6}{E},$$

$$\upsilon_2 = \frac{2.76 \times 10^6}{E}, \quad \upsilon_1 = -\frac{38.45 \times 10^6}{E}$$

(the negative sign indicates downward direction). This proves the discussion above.

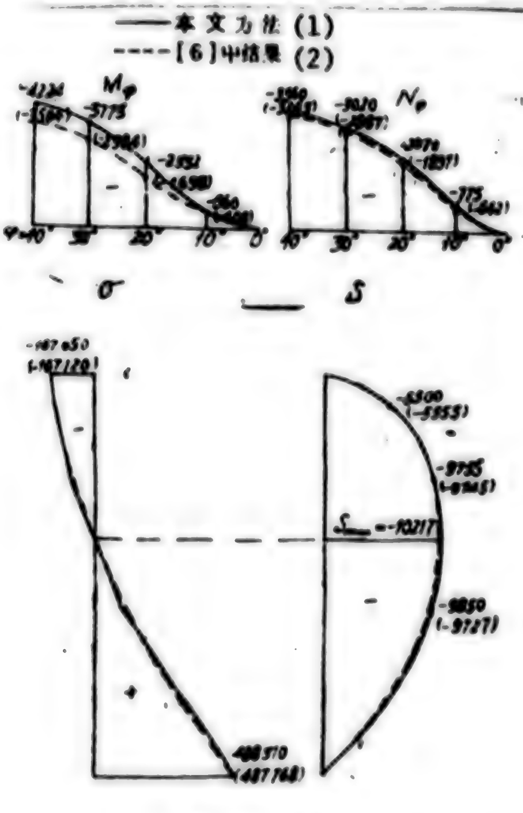

Figure 11.

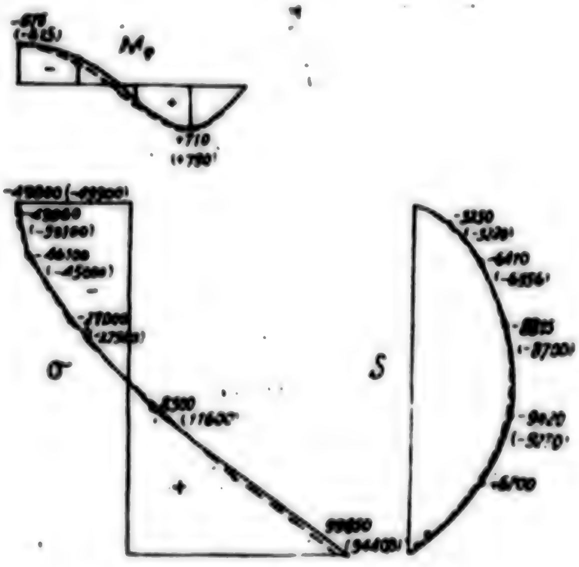

Figure 12.

Key: (1) ———————Method of this article
(2) - - - - - - - - Results on Reference (6)

Example 7. If we change the shell with a side beam in Reference (6) to $\ell = 75'$, shell thickness of 0.3', then $\frac{R}{t} = 100$ and $q = 100^{\#}/_{\circ}{}'$.

Compared to the height of the beam, the width of the side beam is very small, therefore its antitorsion stiffness and sideways antibending stiffness can be neglected, i.e., assuming that the body of the shell at the rim can freely rotate and move sideways.

The computational steps are the same as the above example. The shell is still divided into 8 equal parts, but at this time there is an additional beam stress σ_0. At the same time we notice that there is an additional term $\Delta\sigma_0$ in the total of the added stress and the condition of balance because the area of the section of the side beam and each folded plate are different. At this time, the coefficients of $\Delta\sigma_0$ and $\Delta\sigma_1$ are respectively 2.66 and 3.66. The balancing bending moment can still be used (not in principle because it can be for any point) for the bottom of the shell (or the top of the shell). At this time, the coefficients of the added force inside the balancing equation are still the same as those in the above example. But, the bending moment caused by the added force inside the beam upon the bottom of the shell should be subtracted. Thus, the coefficients of $\Delta\sigma_0$ and $\Delta\sigma_1$ are -8.85 and -3.445. In addition, when calculating υ_0 based on the principle of imaginary work, a vertical unit force should be exerted on the side of the shell, i.e., at the center of the beam. The results of computation of σ, S and M_φ are drawn in Figure 12. The computational results of Reference (8) are included in parentheses in the diagram. They can be seen to be sufficiently close.

2. Calculating the Long Cylindrical Shell in the Housing

Ordinary computational methods of approximation are limited to calculating longer shell bodies.^{9} When $\frac{R}{\ell}$ (or $\frac{\ell 1}{\ell}$) is larger, the effect of the torsional moment upon the longitudinal force cannot be neglected. The effect of the longitudinal shearing force caused by longitudinal bending is generally still not large (see Table 9 in Reference (6)).

We know:

$$M_\varphi = \overline{M}_\varphi \sin kx = \frac{EI}{R^2}\,\frac{\partial^2 w}{\partial\varphi^2},$$

$$M_{x\varphi} = \overline{M}_{x\varphi} \cos kx = \frac{EI}{R^2}\,\frac{\partial^2 w}{\partial x\partial\varphi}.$$

Here: $\overline{M}$ and $\overline{M}_x$ respectively represent the maximum values of the transverse bending moment and the torsional moment at the center of span and at the support.

$$\frac{\partial}{R\partial\varphi}(\overline{M}_{x\varphi}\cos kx) = \frac{EI}{R^2}\,\frac{\partial}{\partial x}\left(\frac{\partial^2 w}{\partial\varphi^2}\right) = \frac{EI}{R^2}\,\frac{\partial}{\partial x}\left(\frac{R^2}{EI}\overline{M}_\varphi \sin kx\right)$$

$$\cos kx\,\frac{\partial\overline{M}_{x\varphi}}{R\partial\varphi} = k\overline{M}_\varphi \cos kx$$

$$\frac{\partial\overline{M}_{x\varphi}}{R\partial\varphi} = k\overline{M}_\varphi \qquad (d)$$

According to the difference method:

$$\frac{\bar{M}^{n+1}_{x\varphi} - \bar{M}^{n-1}_{x\varphi}}{2R\Delta\varphi} = k\bar{M}^{n}_{\varphi} \qquad (e)$$

The order of n increases from the side of the shell to the top of the shell. It can be seen that $\bar{M}_{x\varphi}$ is actually a function of $\bar{M}_\varphi$, i.e.:

$$\bar{M}_{x\varphi} = F_3(\bar{M}_\varphi) \qquad (13)$$

It should be pointed out that under symmetric load, at the top of the shell, $\bar{M}_{x\varphi} = 0$ while $\bar{M}_{x\varphi}$ of each corresponding node point on the two sides are of the same value but of different sign.

After calculating the $\bar{M}_{x\varphi}$ of each node point, the sum of the $\bar{M}_{x\varphi}$ of each corresponding point along the arc length is calculated by numerical integration, i.e., the incremental value $\Delta\bar{M}_\varphi$ (generally opposite $\bar{M}_\varphi$ in (sign) of the torsional moment upon the transverse bending moment at each corresponding node point. Because of computational approximation, here we can approximate the diagram of each piece of $\bar{M}_\varphi$ by a ladder to obtain the product. Therefore the transverse bending moment of a certain node point will not be as simple as described in the previous section, only a function of the load and $\Delta\sigma$, but at the same time it is also a function of every other node point $\bar{M}_\varphi$. Thus in the calculation, the $\bar{M}_\varphi$ should also be taken as an unknown to be solved. At this time, in addition to the unknowns $\Delta\sigma$ and Δ, there are the additional unknown bending moments $\bar{M}_\varphi$ of m node points. But an equation that includes the load, $\Delta\sigma$ and the $\bar{M}_\varphi$ of other node points can be written for each such node point $\bar{M}_\varphi$ (notice that at this time the υ calculated for the transverse direction includes Δ and $\bar{M}_\varphi$, i.e., the first equation in (11)), thus all the unknowns can be solved simultaneously.

If the method of dividing the shell into eight equal parts is used, there would be 5 $\Delta\sigma$ and 3 $\bar{M}_\varphi$ and one Δ unknowns at this time, only one unknown more than those of the method used in Reference (9) (thus it can be seen from example 6 that Δ is easily canceled, and actually the unknowns can be regarded as the same), but that method is unsuited for calculating long cylindrical shells.

Reference (8) points out that when $\frac{R}{L} > 0.6$, taking n = 1 for the Fourier Series is insufficient, n = 3 should be taken. At this time, the load is longitudinally distributed and approaches an even distribution. Calculations show the distribution of the shearing force along the length of the span approaches a straight line more. Thus, for the medium length shell (temporarily taking $\frac{R}{L} > 0.6$ as standard), the calculations are done for an even load and at the same time, it is assumed that along the length of the span the shear force is distributed linearly while the torsional moment and transverse bending moment are approximated as assumed in the previous section.

Example 8. Calculate the Medium Shell in (Table 9) in Reference (6).

Because $\frac{R}{l}$ is very large, the added stress is also large. The graph that varies with the height of the shell along the rim also curves more. Because we have approximated it by a straight line, therefore to obtain a more accurate result, we can take smaller segments for calculation, the 1-2 sections can be further divided equally once (when there is a side beam, the bottom part that exerts a greater effect is the side beam in which the stress originally was distributed linearly, therefore this need not be done).

To check the degree of accuracy of this method of calculation itself, we intentionally used more segments and took 2m = 16 and we used the trial method to solve the problem.

For comparison, we also used the trial method of calculation based on the assumed load and distribution of internal forces mentioned in section 1 and the method of Reference (8) was also used. The results of all calculations are shown in Figure 13. It can be seen that the method of calculation described in this section and the method of Reference (8) are sufficiently close when n = 3. But according to the method in Reference (6) and not considering n = 3, the error of S is larger (an increase of 13.7 percent relative to the value of S when n = 3, otherwise it is 16 percent).

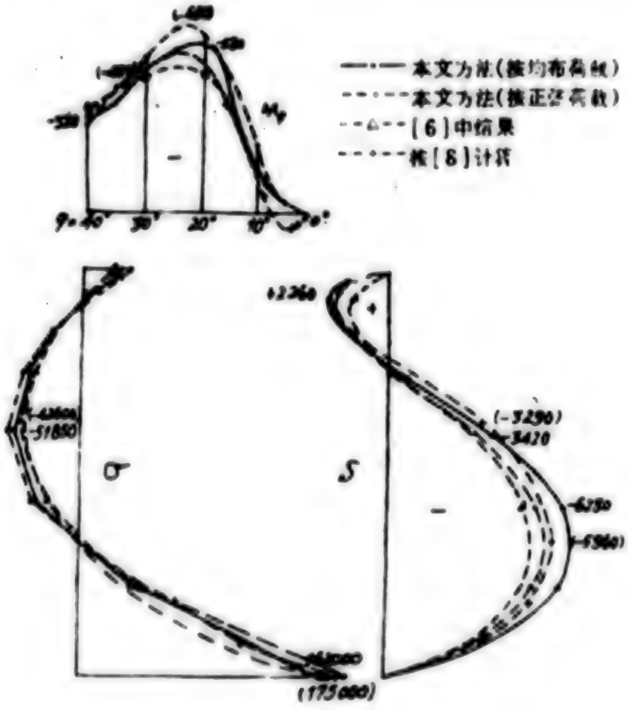

Figure 13.

Key:	
—— · ——	Method of this article (according to an evenly distributed load)
--- · ---	Method of this article (according to sine curve load distribution
--- Δ ---	Results in Reference (6)
--- + ---	Calculated according to Reference (8)

The concepts of mechanics of the new method are clear. The formulas used are all basic (simplified torsional moment formulas should also be regarded as basic formulas) and are easy to remember and grasp. The new method can calculate the long cylindrical shell and can also calculate the medium length cylindrical shell which ordinary approximation methods cannot calculate. In the first situation, the simultaneous equations to be solved have three unknowns less than those in Reference (9), and the amount of computation is greatly lessened. In design, the calculations are sufficiently precise. At the same time, in each folded plate, because the stress in the normal direction is linearly distributed, the total pull needed by the main supporting reinforcement in the longitudinal direction can be accurately calculated, and the greatest stress can also be easily calculated. This method can be popularized and applied in calculating various kinds of supported shells (transverse and longitudinal), shells bearing other types of loads, shells that have variable curvature or two-way shells of different natures.

Here we also point out a problem. In the long cylindrical shell, even when we assume that the load is distributed according to the sine curve, (when using the formula of elasticity theory, take n = 1), the computed stress coincides with the solution S obtained by the elasticity theory, but the vertical component force of these (supports) S only balance this load, thus the total is 20 percent less than the total of the even load. This difference should be taken into account when designing the shell itself or the diaphragm.[8]

When we assume an even load in example 6 and assume the shear force S is linearly distributed along the length of the span, we have:

$$\sigma_1 = 456{,}740^{\bullet}/_{\square'} 、$$

$$\sigma_2 = 95.900^{\bullet}/_{\square'} 、\quad \sigma_3 = -84{,}170^{\bullet}/_{\square'} 、\quad \sigma_4 = -153{,}750^{\bullet}/_{\square'} 、\quad \sigma_5 = -172{,}700^{\bullet}/_{\square'} ,$$

$$M_\varphi^1 = -435^{\bullet\prime}/_{\prime} 、\quad M_\varphi^2 = -1{,}849^{\bullet\prime}/_{\prime} 、\quad M_\varphi^3 = -3{,}165^{\bullet\prime}/_{\prime} 、\quad M_\varphi^4 = -3{,}320^{\bullet\prime}/_{\prime} , \text{ and}$$

$$S_2 = -12.024^{\bullet}/_{\prime} 、 S_3 = -12{,}270^{\bullet}/_{\prime} , \text{及 } S_4 = -7.110^{\bullet}/_{\prime} ,$$

i.e., at this time M_φ further approaches the results based on the elasticity theory and the shear force is greater than the original calculation by 22 percent to 28 percent.

According to the method of lever mechanics, simplified calculations can be performed for the covering of the cylindrical shell (open mouth cylindrical shell), it can also be used to calculate other cylindrical shells such as pipes in round water pools and pipes laid horizontally and bearing vertical loads (closed mouth cylindrical shells).[7] In addition, the solution obtained by lever mechanics can also be used to calculate domes (with the theory of bent moment, including variable thickness). This is not expounded here.

There may be many mistakes and shortcomings in this article. Criticism and corrections are welcome.

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APPLIED SCIENCES

BRIEFS

GEOLOGICAL SURVEY CONFERENCE--The Ministry of Geology recently called a national conference to sum up the achievements and experience in regional geological surveys accumulated by Chinese geologists over the past 30 years. The conference also adopted a regional geological survey plan for 1981 to 1990. Over the past 30 years some 40,000 deposits of 100 different minerals have been located through geological surveys. In addition, geologists have also discovered 376 mineral deposits in various parts of China, of which 85 are large or extremely large deposits. [OW271055 Beijing Domestic Service in Mandarin 1200 GMT 19 Dec 80 OW]

TIME TRANSMITTING STATION--Xi'an, December 26 (XINHUA)--China's time and standard frequency signals across the country have been established in Xi'an. The station, at the Shaanxi Observatory of the Chinese Academy of Sciences, has already registered with the International Tele-communications Union. Eighty specialists and engineers made a final check on the station this week. Testing shows that its transmission accuracy, coverage and capacity are all up to designing requirements. The time transmission is accurate to one-one hundred thousandth of a second. [Text] [OW262229 Beijing XINHUA in English 1217 GMT 26 Dec 80 OW]

CSO: 4008

LIFE SCIENCES

EXPERIMENTS CONDUCTED ON EXCEPTIONAL ABILITY TO DETERMINE DIRECTION

Shanghai ZIRAN ZAZHI [NATURE JOURNAL] in Chinese No 10, Oct 80 pp 741-742

[Article by Zhang Zuqi [1728 4371 0796], Wu Baogang [0702 5508 0474], Tong Litai [4547 0448 3141], Wang Chu [3769 2806], Zheng Lemin [6774 2867 3046], He Muyan [6320 1970 0917], Chen Shouliang [7115 1343 5328], Shao Shaoyuan [6730 4801 3293], Lo Liner [5012 2651 0348], Liu Chaoqian [0491 0340 0051], Beijing University: "An Example of Exceptional Perception Capabilities and Ability To Determine Direction in Humans"]

[Text] Exceptional perception abilities have been previously reported as existing universally in young children.(1,2) In the process of applying their exceptional perception abilities to the recognition of written words and figures, these young children have frequently subjectively sensed the production of a point of light in their brains.(3) We have discovered in some children that the subjective appearance of this point of light changes in brightness according to the direction in which the child is facing. We have wondered whether these children could use this exceptional perception ability to determine direction, and it has been for this purpose that we conducted experiments with Young Lan.

We blindfolded Young Lan using a piece of cloth and placed a colored sheet of paper in her hands. After she reported a point of light in her brain, we spun her around several times, and then had her turn herself in place until the point of light in her brain was at its darkest, and then stand still. The result was that she would stop when facing south and say, the point of light is darkest here. Using this same method, we conducted more than 40 experiments in different buildings near the school (including dark rooms), and each time Young Lan stood still, she was facing essentially southward.

On 16 March 1980, we conducted an experiment in the optics laboratory (with an area of 70 square meters in which doors and windows were shut and the rooms was completely dark) of the physics building of Beijing University. We placed a swivel chair in the middle of the room on which the subject sat. The subject wore a brimmed hat, and right in the middle of the brim was affixed a wooden sliver for indicating direction. The subject's eyes were blindfolded with five layers of red cloth and a colored sheet of paper placed in her hands. After the subject reported a point of light in

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(1) Chen Shouliang et al., ZIRAN ZASHI, 3 (1980) 334

(2) He Muyan et al, ZIRAN ZASHI, 3 (1980) 683

(3) Wang Chu et al, ZIRAN ZASHI, 3 (1980) 438

her brain, the lights were extinguished, and a person turned her around several times in the swivel chair in an alternate clockwise and counter-clockwise directions, stopping in a random direction. Others involved in the experiment were at a distance of from 4 to 5 meters from the subject, and they shifted positions after the lights were out, keeping silent while doing so. After the spinning was completed, the subject herself turned the position of her chair, stopping when she perceived the point of light in her brain to be at its darkest. Then the lights were turned on and a pocket compass used to determine the position in which the wooden sliver on the brim of the subject's hat was facing. Results from a total of six such experiments are shown in Table 1.

Table 1

Number of Times	Direction and Number of Spins of Subject	Position Subject Finally Faced
1	Clockwise more than 3 times and counter-clockwise more than 4 times.	Directly south
2	Clockwise more than 4 times, and counter-clockwise more than 3 times	South 5° west
3	Clockwise more than 2 times, and counter-clockwise about 2 times	South 7° west
4	Clockwise about 2 times, and counter-clockwise more than 2 times	South 5° west
5	Clockwise more than 3 times, and counter-clockwise about 2 times	Directly south
6	Clockwise more than 5 times, and counter-clockwise more than 3 times	South 5° west

On the afternoon of 23 March 1980, an experiment was conducted in a laboratory (with an area of 30 square meters around which black curtains were hung over the windows) in the west experimental hall of the biology department. Methods used were identical with those of 16 March, and results are as shown in Table 2.

Table 2

Number of Times	Direction and Number of Spins of Subject	Position subject finally faced
1	Clockwise more than 2 times, and counterclockwise 2 times	Directly south
2	Clockwise more than 2 times, and counter-clockwise more than 2 times	Directly south
3	Clockwise about 3 times, and counter-clockwise about 2 times, then clockwise about once	Directly south
4	Clockwise more than 2 times, and counter-clockwise 2 times	Directly south
5	Clockwise about 2 times; counter-clockwise more than once; then clockwise once	Directly south
6	Clockwise about 3 times; counter-clockwise about 3 times; then clockwise more than once	Directly south

It may be seen from the aforestated several experiments that Little Lan, who has exceptional perception abilities, was able to accurately determine direction and point southward by using the degree of lightness or darkness of a subjectively appearing light spot.

When determining direction, even though Little Lan did not move the trunk of her body but only revolved her head, she experienced a change in the degree of lightness and darkness of the subjective light spot. Usually she would turn her body in a more or less complete circle until she was facing generally south, and then she would turn her head to accurately determine south. Therefore, we infer that it is the head that receives certain external stimuli, causing the subjective light spot to change its degree of lightness or darkness in accordance with direction.

In order to check whether this ability of Young Lan's was related to her body's sensitivity to terrestrial magnetism. we conducted experiments using an external magnetic field to change the static magnetism in the space Young Lan occupied. The first such experiment was conducted during the afternoon of 8 April 1980. In the magnetism laboratory of the physics building, a set of Helpholtz coils measuring one meter in diameter were used to set up a magnetic field with a level of magnetic force exactly opposite that of the earth's magnetism. The face of the Helpholtz coils was in the north-south direction, and during the period of the experiment, Young Lan was placed outside the coil. A compass and a gaussmeter were used to determine and to define the direction and the amount of magnetism being received by the subject's head and chest.

Conditions of the Experiment:

1. When the current in the coil was 80 milliamperes, the compass needle in the space occupied by the subject's head and chest was unable to point in a north-south direction, i.e. the level of magnetic force in these positions was very weak.

2. When the current in the coil was 160 milliamperes, the compass needle would show a reverse reading when in the space occupied by the subject's head and chest.

3. When the current in the coil was 900 milliamperes, the coil produced a magnetism eight times the force of earth magnetism.

4. When the current in the coil was 14 amperes, a CT-5 gaussmeter used in the space occupied by the subject's head and chest registered a magnetic force of 25 gauss. In that position, the level of magnetic force was in the reverse direction of the level of force of earth magnetism, and about 100 times greater than the level of force of earth magnetism.

5. During the experiment, black curtains covered the windows of the laboratory; the lights were extinguished; and a red cloth covered Young Lan's eyes. After she reported the appearance of the subjective light spot in her brain, she was rotated in place and both moved and rotated at the same time. After being moved to the space where magnetism was being produced, she was again rotated several times and let loose so she could rotate her own torso and determine direction. We conducted the experiment under the three conditions given in conditions 2, 3, and 4 above, and each time an experiment was conducted, a control experiment was also conducted (without the addition of a magnetic field) for a total of five times. In every case, Young Lan was able to accurately determine south.

On the evening of 13 April 1980, the experiment was again conducted under identical conditions for a total of five times, with a control experiment being conducted first in which magnetism from the coil was not added. Next, one experiment was conducted under each of the conditions 1, 3, and 4 above. The fifth time, two pieces of strontium ferrite with a surface force of 900 gauss were placed in an east-west direction alongside Young Lan's head, the distance between the two ferrites being 30 centimeters. The field of force in the center of that area was 30 gauss (Figure 1). The result was that Young Lan was able to accurately determine the south direction as always.

Inasmuch as it was not possible to strictly determine the location of the sensor in Young Lan's body, we performed the third experiment on the afternoon of 26 April 1980. After spinning Young Lan around, we had her sit on a small stool so that her entire body was within the field of magnetism generated by the coil (Figure 2). Individual magnetic forces in the opposite direction of the level of the earth's magnetism tested at the time by the gaussmeter were: tips of the toes, 6 gauss (weakest); head, 20 gauss (strongest). Both experiments and controls were conducted once, and the results showed Young Lan still able to accurately determine the direction of south.

On the basis of the results of the 12 experiments discussed above, we preliminarily believe that Young Lan's ability to determine direction is unrelated to any direct perception of levels of magnetic force in the earth.

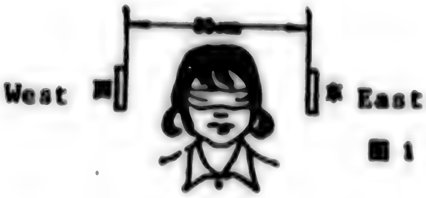

图 1 Figure 1

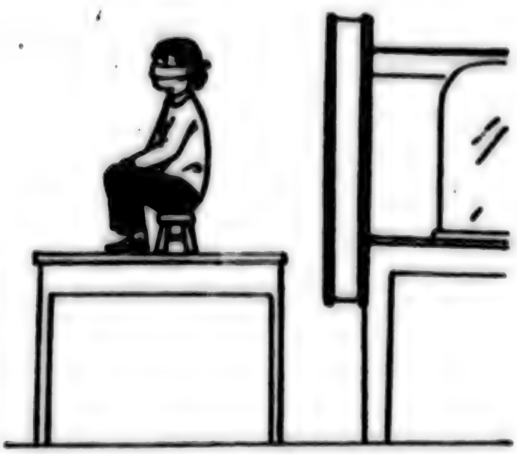

图 2
Figure 2

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TITLE: "Some Analyses of Transient Characteristics of Thickness Mode Piezoelectric Transducers by Using Mason's Equivalent Circuit"

SOURCE: Beijing SHENGXUE XUEBAO [ACTA ACUSTICA] in Chinese No 4, Nov 80 pp 249-257

EXCERPT FROM ENGLISH ABSTRACT: We computed, by using Mason's equivalent circuit, the acoustic waveforms radiated by thickness-mode piezoelectric circular transducers possessing various structure parameters and being excited by a step voltage. We also computed the electrical waveforms produced by these transducers when they were used for receiving as well as for transmitting, the radiated acoustic pulses being reflected by a plane boundary. Measurements were made with a thin measuring transducer at a close range in the first case and with the reflector, also very close to the transducer, in the second case. On comparing the theoretical and the experimental results, it may be seen that in spite of the fact that Mason's equivalent circuit is a one-dimensional model, computed results are reasonably applicable. Some theoretically predicted details, such as the asymmetry of the radiated acoustic waveforms about the time axis, are experimentally confirmed. But then there remain

[Continuation of SHENGXUE XUEBAO No 4, Nov 80 pp 249-257]

some yet to be elucidated problems, such as to what extent does the assumption hold that the radiated ultrasonic wave is a plane.

The influence of the wear plate is briefly discussed. Illustrations are given showing that distortion in the waveform and change in the apparent ultrasonic frequency become more prominent when the thickness increases. Mention is made of the possibility of controlling the electrical waveform obtained from a transmitting-receiving transducer such that the maximum of its envelope is to occur either at the very beginning or at some later cycle.

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TITLE: "Generation Characteristics of SAW in the Excited Interdigital Transducers"

SOURCE: Beijing SHENGXUE XUEBAO [ACTA ACUSTICA] in Chinese No 4, Nov 80 pp 258-269

EXCERPT FROM ENGLISH ABSTRACT: The characteristics of the spatial growth of a surface acoustic wave (SAW) in the excited interdigital transducers (IDT) are observed and measured quantitatively. Both the method of dark field imaging and that of simple optical probing have been used. In the experimental set-up, the detected optical intensity is the result of superposition of both diffracted optical beams produced by the acoustic waves propagating in two opposite directions. The periodic IDT and linear FM IDT deposited on the substrates of Y-cut Z-propagation $LiNbO_3$ have been investigated. For the periodic IDT, the experimental investigations show that the superposed intensity of SAW in the central position of IDT is minimal, then it grows with the distance from the center section. The growth is symmetric in both directions of the excited IDT. In the case of linear FM IDT, the experimental results indicate that in the central position of the resonantly excited finger pairs the superposed intensity of SAW is minimal, also, but then with the distance from the central position the spatial growth of SAW in two directions is asymmetric.

[Continuation of SHENGXUE XUEBAO No 4, Nov 80 pp 258-269]

Theoretical calculations are also made two ways. One of them is performed by the multiplication of the admittance matrices as employed by Smith, considering impedance discontinuity at each interdigital electrode edge. The other can be obtained from the analytical expression of the generation characteristic of SAW for periodic IDT, which is derived by Shui. The results obtained by both methods roughly agreed with each other. The experimental data may be explained qualitatively by these theories, but some discrepancies are presented and discussed briefly.

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TITLE: "Analyses of Underwater Coherent Sound Source"

SOURCE: Beijing SHENGXUE XUEBAO [ACTA ACUSTICA] in Chinese No 4, Nov 80 pp 270-278

TEXT OF ENGLISH ABSTRACT: The problem of how to emit the sound energy convergently in an unbounded uniform medium has been solved in terms of the directivity index. Coherent source is used to focus radiation energy in the shallow stratified medium. The main results are given as follows:

(1) In a homogeneous layer, the coherent source retains waveguide propagation from Weston's B-region to C-region;

(2) In a negative gradient layer, it provides significant convergence gain as the focus depth of the source insonifies shallow target;

(3) In a negative thermocline layer, the powers rushing the jump domain and bounding under layer waves by coherent source are higher than those by point source.

In addition, with three common sonar systems as illustrations, we calculate relative correlation gains of coherent sound sources.

AUTHOR: JIN Guoliang [6855 0948 0081]

ORG: Institute of Acoustics, Chinese Academy of Sciences

TITLE: "Average Intensity of Long Range Shallow Water Reverberation under Isovelocity Conditions"

SOURCE: Beijing SHENGXUE XUEBAO [ACTA ACUSTICA] in Chinese No 4, Nov 80 pp 279-285

TEXT OF ENGLISH ABSTRACT: When the main source of shallow water reverberation under isovelocity conditions is bottom backscattering, the approximate expressions of average reverberation intensity at long range are derived in terms of normal-mode theory and the ray-mode interrelationship. In the case of the source and receiver being nondirectional, it is shown that the reverberation intensity is proportional to r^{-3} for Lambet's scattering and proportional to $r^{-5/2}$ for omnidirectional scattering. In the other case, the source and receiver are directional, and the reverberation intensity can also be calculated with normal-mode theory. Finally, the difference between the results in the two cases is discussed and a critical range, over which the difference can be neglected, is given.

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TITLE: "A Method of Pitch Extraction by LPC Analysis with Predetermining Voiced Sounds"

SOURCE: Beijing SHENGXUE XUEBAO [ACTA ACUSTICA] in Chinese No 4, Nov 80 pp 286-290

EXCERPT FROM ENGLISH ABSTRACT: A method of pitch extraction by Linear Prediction Code (LPC) analysis with predetermined voiced sounds is presented in this paper. At first, the voiced parts in the speech signal are identified by the difference $a_0 - a_1$, where $a_0 = 1$ and a_1 is the first coefficient of the linear predictor; then only the voiced parts are processed to extract the pitch period. When pitch detecting, the data rate is compressed by half, the eight coefficients of inverse filter are calculated by autocorrelation LPC method, and then for the residual signal, the output of the inverse filter, the pitch period is extracted by the Average Magnitude Difference Function (AMDF) method, and the curve of the pitch period is linearly interpolated and nonlinearly filtered.

The results obtained by our method are compared with those obtained by a semi-automatic pitch detector and by the SIFT method. It is shown that the algorithm

[Continuation of SHENGXUE XUEBAO No 4, Nov 80 pp 286-290]

presented in this paper is quite precise and effective for continuous speech with background noise below 40 dB. It is unnecessary to calculate the pitch periods in voiceless sounds and silence periods, and the classification of voiced or unvoiced sounds is rather precise.

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TITLE: "The Theory and Applications of Linear Prediction of Speech Wave"

SOURCE: Beijing SHENGXUE XUEBAO [ACTA ACUSTICA] in Chinese No 4, Nov 80 pp 291-300

TEXT OF ENGLISH ABSTRACT: The theory of Linear Prediction (LP) of speech waves is summarized in this paper, especially the autocorrelation LP method and selective LP method. The iterative solution process of autocorrelation normal equation is presented. It is pointed out that the selective LP method has special applications in specific problems, such as speech recognition. Some new basic parameters and calculations used for speech recognition are presented. It is emphasized that the LP parameters are quite useful in Vocodic speech recognition. The other applications of LP, such as Formant extraction and pitch detection of voiced speech, are also pointed out.

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TITLE: "Development of Real-Time Air-Gap Coupled SAW Convolvers"

SOURCE: Beijing SHENGXUE XUEBAO [ACTA ACUSTICA] in Chinese No 4, Nov 80 pp 301-303

EXCERPT FROM ENGLISH ABSTRACT: This short paper is on the development of real-time air-gap coupled SAW convolvers. The convolver is "degenerate." Its center frequency is 60 MHz, the interaction length 8 μs, untuned convolution efficiency $F_{Te} = -66$ dBm, tuned $F_{Te} \geq -57$ dBm, and the figure of $M = 6.1 \times 10^{-3}$ V·m/W.

We have conducted two experiments using the modulated square pulses and the linear chirp signals by our convolvers. These experimental results were satisfactory.

AUTHOR: LIU Jingchang [0491 2529 2490]

ORG: Naval Medical Research Institute

TITLE: "The Influence of Breathing Helium-Oxygen Mixture under High Pressure on Speech and Function of Vocal Organ During Phonation"

SOURCE: Beijing SHENGXUE XUEBAO [ACTA ACUSTICA] in Chinese No 4, Nov 80 pp 304-309

EXCERPT FROM ENGLISH ABSTRACT: The purpose of this paper is to investigate the changes in speech formants when human subjects breathed $He-O_2$ mixtures at a high pressure environment, and compares the capacities in maintaining fundamental voice frequencies with electromyograms in the laryngeal region during pronunciation under the same conditions. The results are as follows:

When subjects breathed $He-O_2$ mixtures at high pressures, the vowel formant frequencies shifted upward, particularly the second formant frequencies, such that $F_{He} = (1.2 - 1.5)\ F_{air}$.

When subjects were repeatedly exposed to the $He-O_2$ mixtures, their capacities in maintaining fundamental frequencies were improved, showing adaptable changes, but the changes of the formant could not naturally restitute and had to be modulated manually.

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The duration from occurrence of the electromyogram changes to a burst of the voice during pronunciation in $He-O_2$ mixtures was 0.1 - 0.3 seconds shorter than in air, and during pronunciation the increases of cular voltage in $He-O_2$ were less obvious than in air.

The fundamental frequencies of speech, whether in $He-O_2$ or in air, were much higher than the frequencies of the electromyogram, and were not synchronous with the latter.

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TITLE: "The Growth of New Single Crystals of BGS ($Bi_{12}Ge_xSi_{(1-x)}O_{20}$) Series with Low Sound Velocity Using Czochralski Method"

SOURCE: Beijing SHENGXUE XUEBAO [ACTA ACUSTICA] in Chinese No 4, Nov 80 pp 310-313

EXCERPT FROM ENGLISH ABSTRACT: Six kinds of new single crystals of BGS ($Bi_{12}Ge_x Si_{(1-x)}O_{20}$) series with lower sound velocity have been grown using the Czochralski method, with sizes of about 15 x 15 x 80 mm^3. The single crystals of the BGS series belong to the cubic system, 23 class, I23 or $I2_13$ space group. Their cell constants are $a \approx 10.11$ Å.

The densities are between 9.20×10^3 kg/m^3 (BG) and 9.30×10^3 kg/m^3 (BS). The velocities of extensional wave in (100) direction are $v = 3.7 \times 10^3$ m/s approaching those of the BG and BS crystals.

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TITLE: "Design of Arc Transducer Array with Heart-Shaped Directivity"

SOURCE: Beijing SHENGXUE XUEBAO [ACTA ACUSTICA] in Chinese No 4, Nov 80 pp 314-317

EXCERPT FROM ENGLISH ABSTRACT: An arc transducer array with heart-shaped directivity has been made. The frequency is 100 kHz under water, the electric impedance is 140 Ω and the mechanical Qm is 6. The pressure at an angle ±60° was found to be 12 dB higher than that of a 0° angle. The transmitting voltage sensitivity of an arc at a 60° angle is 163 dB and the acoustical source level is 215 dB (Ye 1 μPa/v.m).

The transduce array has a radius of 15 cm, consisting of two identical arcs. The radiating surface of the arc is a curved copper plate to which all the chord source is cecented by epoxy resin.

In view of the fact that chord sources were not accompanied by any backward radiation and that the radius of the array considerably exceeds the wavelength in water, the results obtained by treating the far-field acoustic pressure with methods employed in ray acoustics are consistent with our experimental data.

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CSO: 4009

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TITLE: "Relationship Between Deformation of the Surrounding Rock and the Layout of the Gateways Driven in Different Slices of a Thick Coal Seam"

SOURCE: Beijing MEITAN KEXUE JISHU [COAL SCIENCE AND TECHNOLOGY] in Chinese No 9, Sep 80 pp 2-8

TEXT OF ENGLISH ABSTRACT: Based on the observed deformation and maintenance data collected from Pingdingshan, Yangquan and Kailuan mine areas, this paper gives a specific analysis of the gateway layouts in the upper, middle and lower slices of a thick seam won by the inclined slicing method in descending order with caving; the patterns of deformation of the surrounding rock, and their changes in different periods and under different conditions. The variations of deformation values of the surrounding rock under certain given conditions are presented together with their corresponding maintenance costs, etc. Finally the problems related to the entry layout in mining a thick seam with the slicing method, which need attention, are also pointed out.

AUTHOR: None

ORG: Frequency Depth-Measuring Group, Institute of Geological Surveying, Academy of Coal Sciences

TITLE: "Plates for Depth Measuring by Electromagnetic Method"

SOURCE: Beijing MEITAN KEXUE JISHU [COAL SCIENCE AND TECHNOLOGY] in Chinese No 9, Sep 80 pp 15-21

TEXT OF ENGLISH ABSTRACT: Briefly described are different types of measuring plates (groups of theoretical curves), the scope of the earth's conductivity, the quantity of measuring plates and their precision. It also presents the mathematical treatment of the theoretical curves of the measuring plates, the programming and its relation to the measured curve. Explanations of five plates plotted with different values of ρ_ω^{Ex} (the horizontal electric field apparent resistivity) and ρ_ω^{Hz} (the vertical electric field apparent resistivity) are given as examples to depict their relationship. This paper gives a general idea of the characteristics, usage and specifications of the theoretical measuring plates.

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TITLE: "Design Calculations for Deep Shaft Compound Linings by the Freezing Method"

SOURCE: Beijing MEITAN KEXUE JISHU [COAL SCIENCE AND TECHNOLOGY] in Chinese No 9, Sep 80 pp 28-32

TEXT OF ENGLISH ABSTRACT: Calculating principles for designing the compound shaft lining (including the inner and outer cylinders) for deep shafts are proposed based on the constructional features of freezing deep shafts in China. Basic formulas have been deduced using the theory of elasticity and principles applicable to a thick wall cylinder. In light of these formulas, structural configurations and materials for the lining can be chosen and the thickness of each cylinder of the compound lining can be determined so as to suit the hydrological, geological and ground pressure conditions and the requirements of diameter and depth of the shaft. The calculating and checking procedures are described. Also, some examples are given.

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TITLE: "Reviews on the Coal Measuring System"

SOURCE: Beijing MEITAN KEXUE JISHU [COAL SCIENCE AND TECHNOLOGY] in Chinese No 9, Sep 80 pp 33-35

TEXT OF ENGLISH ABSTRACT: This paper depicts the necessity of innovating the prevailing raw coal measuring system and the advantages of such a system. This system would take the saleable coal (containing 21 percent ash as a working basis) with a net calorific value of 5600 Kcal/kg as the standard coal. Transitional measures in changing from the old system to the new system are proposed.

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TITLE: "The Instrumental Form for Construction of the Main Building of a Coal Preparation Plant"

SOURCE: Beijing MEITAN KEXUE JISHU [COAL SCIENCE AND TECHNOLOGY] in Chinese No 9, Sep 80 pp 41-45

TEXT OF ENGLISH ABSTRACT: The economic effects, design, fabrication and site installation and dismantling of the instrumental form are dealt with. It analyzes the structural features of the instrumental form and points for attention in binding reinforcement and placing concrete. It points out that the use of this kind of form is one of the effective approaches for building multi-storied frame structures for a coal preparation plant.

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CSO: 4009

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ORG: None

TITLE: "Intussusception--A Complication Observed in Acute Radiation Sickness and Combined Radiation Injury"

SOURCE: Beijing JIEFANGJUN YIXUE ZAZHI [LIBERATION ARMY MEDICAL JOURNAL] in Chinese Vol 5 No 6, Dec 80 pp 321-324

ABSTRACT: There have been a number of reports of observations of intussusception to be one of the complications in the recovery period of acute radiation injury but there is no agreement as to the rate of its occurrence. This paper reports a study on 562 dogs of artificially induced radiation sickness. After irradiation with ^{60}Co of various dosages, 20 died, 46 developed brain type radiation sickness, 256 the intestinal type, and 239 the bone marrow type. All were dissected and 23 cases of intussusception were observed in the entire group, amounting to 4.09 percent. Intussusception as the major cause of death is analyzed and discussed.

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TITLE: "Bone Marrow Megakaryocytophagia in Various Injuries"

SOURCE: Beijing JIEFANGJUN YIXUE ZAZHI [LIBERATION ARMY MEDICAL JOURNAL] in Chinese Vol 5 No 6, Dec 80 pp 325-328

ABSTRACT: In 1963, in studying disorders during late recovery stage from acute radiation sickness in dogs, the authors discovered the phenomenon of phagokaryosis by neutrophile granulocytes. Since then, they have observed the same phenomenon in experimental dogs during the recovery stage from injuries induced by x-ray, nuclear explosion, compression, and burns. This paper is a comprehensive report of the authors' understandings of this disorder, its morphological characteristics, the conditions of its occurrence, and its genetic principal and its significance in light of more recent observations of the same authors.

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ORG: None

TITLE: "Histochemical Observation of 3 Enzymes in Peripheral Blood Leukocytes of Patients Suffering From Malignant Tumors"

SOURCE: Beijing JIEFANGJUN YIXUE ZAZHI [LIBERATION ARMY MEDICAL JOURNAL] in Chinese Vol 5 No 6, Dec 80 pp 343-346

ABSTRACT: Using histochemical techniques, the authors observed the leukocytes of the peripheral blood of 100 cases of malignant tumors to analyze the positive rate and activity of mATP, the SDH, and the AKP. All the patients of the group suffer from malignant tumors of the non-blood type, including 20 cases of liver cancer, 20 gastric cancer, 15 esophageal cancer, 13 rectal cancer, 17 lung cancer, and 15 others. None of them had blood transfusion within 2 weeks of the test and the majority (94 cases) had had no chemotherapy. Diagnoses of these patients had been verified through biopsy or surgery before blood specimens were taken from the ear lobes. Results of the study are reported and analyzed.

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TITLE: "Study on the Rapid Detection of Bacillus Anthracis"

SOURCE: Beijing JIEFANGJUN YIXUE ZAZHI [LIBERATION ARMY MEDICAL JOURNAL] in Chinese Vol 5 No 6 Dec 80 pp 347-349, 374

ABSTRACT: Through experimental studies and specimen observations, fast culture techniques and rapid detection techniques, including monilated fluorescent antibodies, membrane fluorescent antibodies, etc. were found to be highly specific and sensitive when they were used to examine water, surface of articles, and tissues of diseased men and animals. Rapid identification of anthrax remains difficult in case of specimens of soil and water containing numerous other germs and foreign substance and very few Bacillus anthracis, however. Further research is awaited.

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AUTHOR: CHEN Shanmin [7115 6365 2404]

ORG: National Meteorological Center, Beijing

TITLE: "Days and Nights at National Meteorological Center, Beijing"

SOURCE: Beijing XIANDAIHUA [MODERNIZATION] in Chinese Vol 2 No 11, 16 Nov 80 pp 1-2, inside front cover

ABSTRACT: The nine-story white building to the north of Zizhuyuan Park in the west suburb of Beijing, housing the National Meteorological Center (NMC), was completed several years ago. At present, it operates as the headquarters of worldwide meteorological communication, a center of weather analysis and forecasting in China, and a national archive for storing weather data of the more than 2,000 weather stations of the country. The paper describes the functions and capabilities of the NMC. Photos depicting the graphic and computation equipment of the NMC are reproduced on the inside front cover of the issue.

AUTHOR: SHEN Hao [3088 1472-3082]

ORG: Institute of Sonics, Chinese Academy of Sciences

TITLE: "Noise--A Pollution Not Easily Ignored"

SOURCE: Beijing XIANDAIHUA [MODERNIZATION] in Chinese Vol 2 No 11, 16 Nov 80 pp 6-7. 45, inside back cover

ABSTRACT: The paper first relates an experiment carried out at the institute by placing 3 mice in a glass-enclosed chamber with sound measuring 165 db piped into the chamber. Several minutes later, all 3 mice died. Photos of these mice in the experimental chamber are reproduced on the inside back cover. The paper proceeds to explain that noise beyond a certain level in an enclosed environment is not simply a matter of annoyance. Noise pollution can cause loss of hearing, damage to the central nervous system, loss of equilibrium of the cerebral cortex, arrhythmia, vascular spasm, hypertension, hardening of arteries, and a host of other physical disorders. Noise of jet airplanes has been known to cause chickens to shed feathers, to stop laying eggs, to develop internal breeding, and to die. Most recently, many countries have formulated laws to regulate noise levels and to improve the acoustic conditions of buildings. The author and colleagues believe that so long as the leaders in China pay attention to the harmful effects of noise pollution it will be possible to control it.

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